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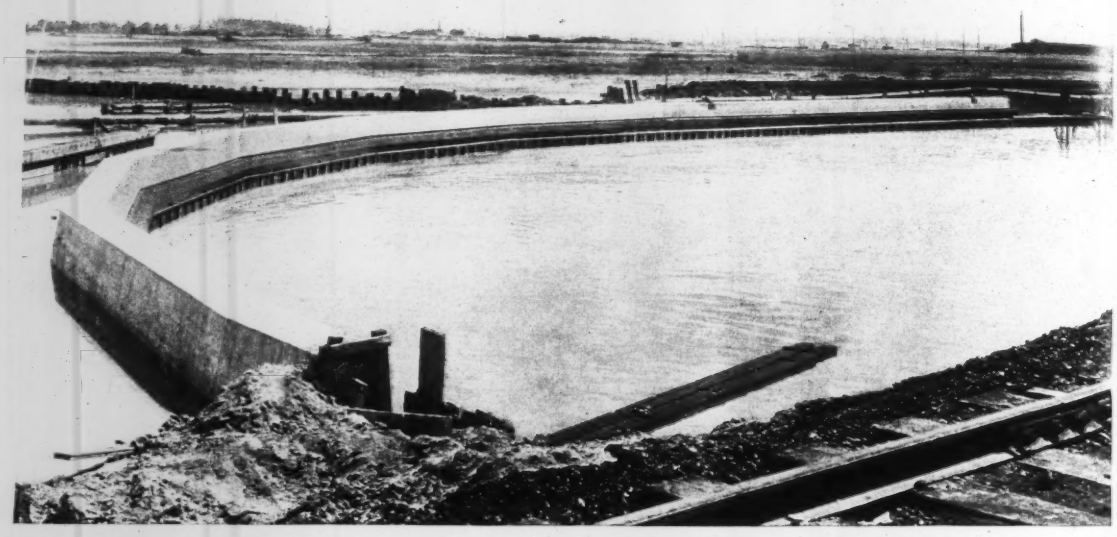

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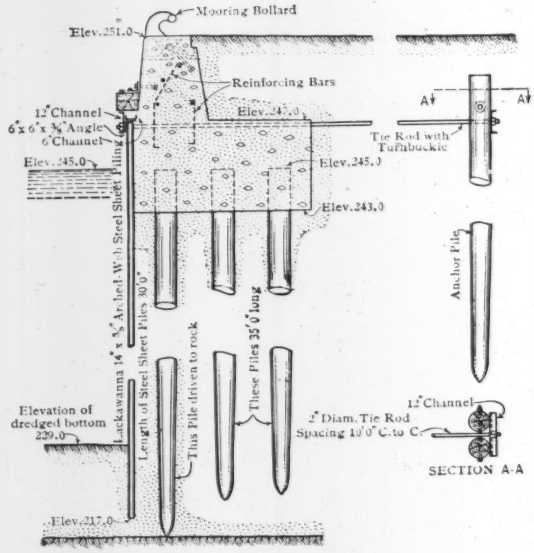

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Engineering News

VOLUME 75 JUNE 8, 1916 NUMBER 23

Plate Girders of Record Weight in Worcester Viaduct

By F. B. Freeman*

Reference was made in *Engineering News* of Dec. 9, 1915, in the course of the description of long plate girders for the Nickel Plate railroad at Chicago, to the fact that much heavier girders were used in grade-crossing elimination at Worcester, Mass., three years ago. These heavy girders were constructed by the Boston & Albany R.R. (not by the New York, New Haven & Hartford R.R., as stated in the article). A description of some of the interesting features of these girders is given below.

The elimination of grade crossings through Worcester, Mass., necessitated the construction of an unusually long and heavy solid-floor viaduct at South Worcester to carry the tracks of the Boston & Albany R.R. across Southbridge St. and the tracks of the New York, New Haven & Hartford R.R.

The four tracks of the latter road cross Southbridge St. by means of a through truss span at a distance of about 26 ft. below the tracks of the Boston & Albany, which cross the street on a deck truss span. The tracks of the New York, New Haven & Hartford run parallel to those of the Boston & Albany until they reach the westerly end of the truss span, when they make a turn south and pass beneath the Boston & Albany tracks, which cross them by means of several plate-girder spans carried on two piers. From a freight yard north of the bridge three tracks of the New York, New Haven & Hartford join with two of the main tracks at a point beneath the westerly span of the bridge.

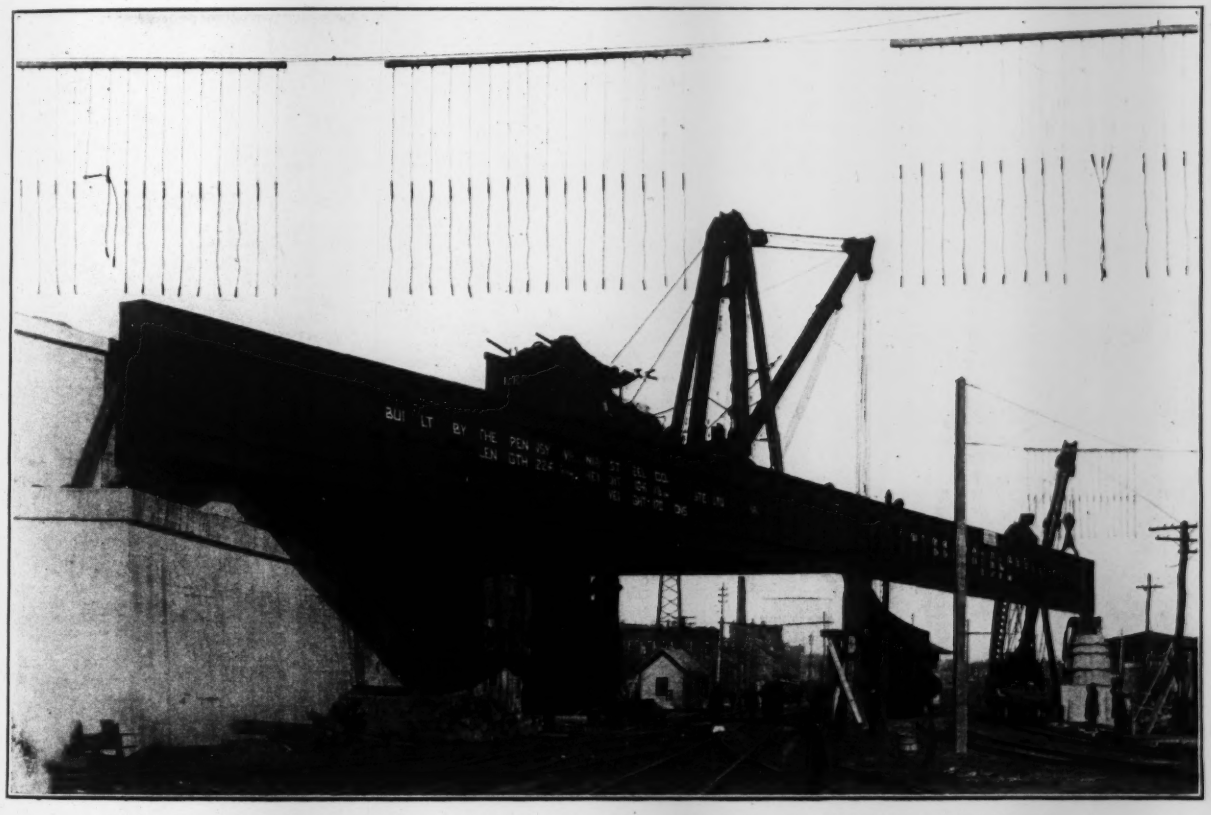


FIG. 1. THE 170-TON PLATE GIRDER IN PLACE; ERECTING THE ADJOINING GIRDER G3
Part of floor-beams to abutment in place

*Chief Engineer, Boston & Albany R.R.; South Station, Boston, Mass.

With this layout of tracks and crossovers and switches it was necessary to divide the portion of the bridge west of Southbridge St. into three spans of deck plate-girders, supported on a pier between the two middle tracks of the New York, New Haven & Hartford R.R., a pier south of the southerly main tracks, and two abutments, one west of the New York, New Haven & Hartford tracks and the other at the end of the Southbridge St. truss span. Referring to the plan, it will be seen that the westerly pier was constructed on a curve parallel to the at right angles to the abutments and piers and [illegible]ing into long girders. The span over Southbridge [illegible] is made up of five lines of deck riveted Warren [illegible]sses with a floor system of I-beams resting on the top [illegible] the trusses. The entire bridge floor is covered with a [illegible]nforced-concrete slab.

The floor girders over the New Haven railroad [illegible]racks are entirely incased in concrete, with a slab on the [illegible]nder side to eliminate all pockets which might hold [illegible]omotive gases. In the under side of this slab are [illegible]edded

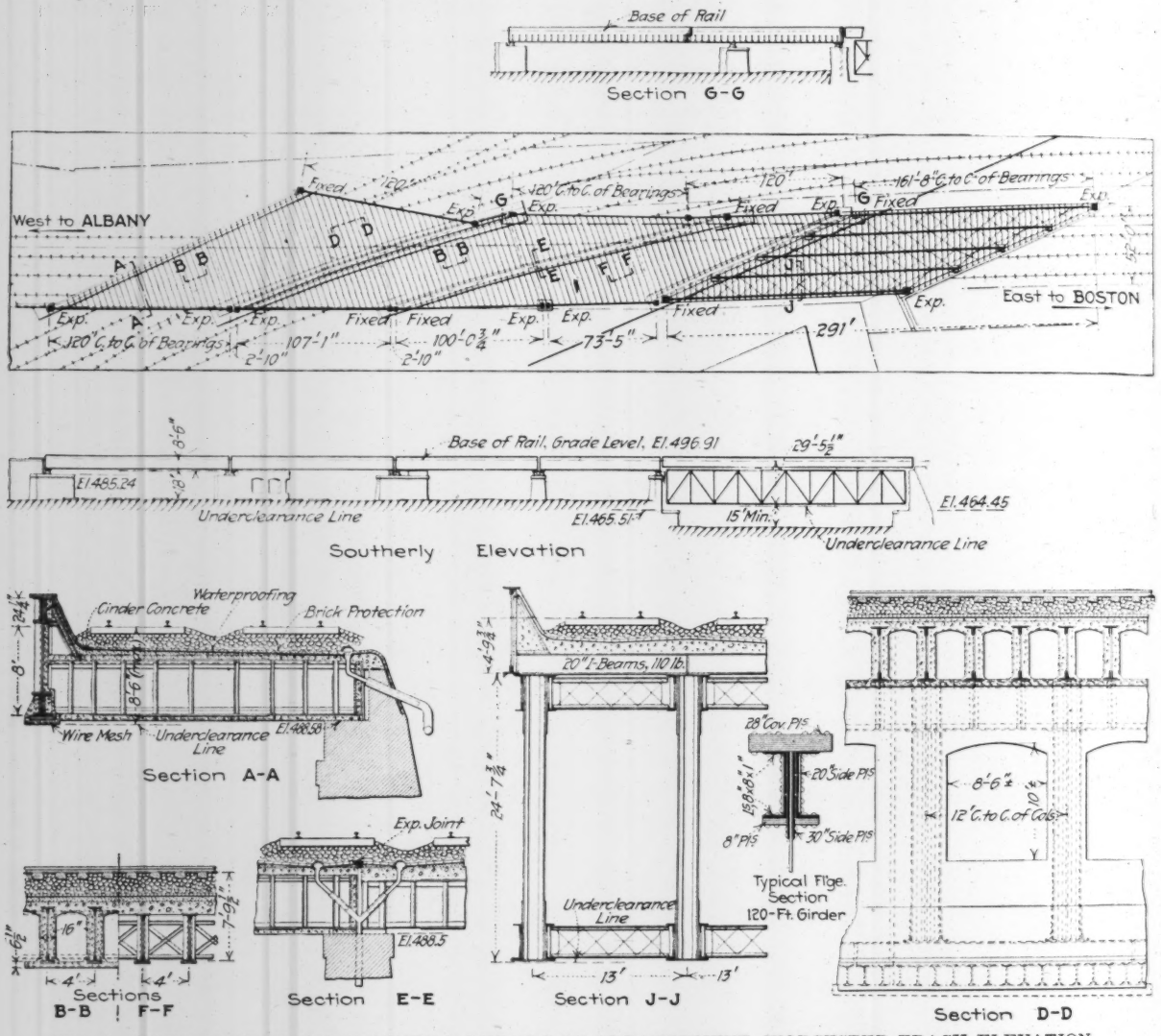


FIG. 2. GENERAL PLAN AND ESSENTIAL DETAILS OF ARRANGEMENT, WORCESTER TRACK ELEVATION, BOSTON & ALBANY R.R.

adjoining tracks, in order to obtain the required side clearance at all points. The west abutment was built parallel to the extreme westerly yard track of the New Haven railroad, which, being on a tangent, was at no point parallel to the pier. The easterly pier, adjacent to the southerly New Haven main track, was built parallel to it. The abutment on the west side of Southbridge St. was built on the street line. None of the piers or abutments except those of the street span were parallel to each other.

In general, the superstructure, except for the street span, consists of deck plate-girders placed approximately hard-glazed tile for protection against the locomotive blast. The girders between the truss span and the easterly pier adjacent to the tracks are not incased. The bottom flanges of the long fascia girders were incased in concrete and the portions directly over the tracks are protected from the locomotive blast by cast-iron blast guards. The entire floor slab is covered with a crowning of cinder concrete to afford the necessary slopes to carry drain water. This cinder-concrete crown is covered with a 2-ply thickness of Minwax waterproofing, protected by a layer of brick. Regular track construction with stone ballast is placed over the entire floor.

The most interesting features in connection with this bridge were the construction and shipment of the heavy plate girders.

The shortest distances between the piers and abutments were at the south side of the bridge, where the maximum length of the girder required, at the southwest end of the bridge, was 122 ft. 6 in. overall. This length of 122 ft. 6 in., girder *G4*, was established as a limit. In order to keep the girders on the north side of the bridge within this limit, it was necessary to construct the northwest girder at an angle to the tracks. The girder between the Southbridge St. abutment and the easterly pier was constructed with a cantilever arm of 26 ft. overhanging the pier, in order to keep the next girder west, *G6*, within the established limit for length. This girder was also placed at a slight angle with the tracks for the same reason.

Girder *G4*, the southwesterly one, is the heaviest in the structure, weighing 170 tons. Its dimensions are: Length 122 ft. 6 in., depth 10 ft. 11½ in. Each flange is made up of four 8x8x1-in. angles, two side plates 6x1 in.; two side plates 30x1 in.; nine cover plates 28x⅝ in., and six plates 8x¾ in. The main web of the girder is 1 in. thick throughout, with a 1-in. reinforcing web at the east end (which receives the greater reaction). The 30x1-in. side plate is discontinued at the point where the reinforcing web begins and is spliced to this web.

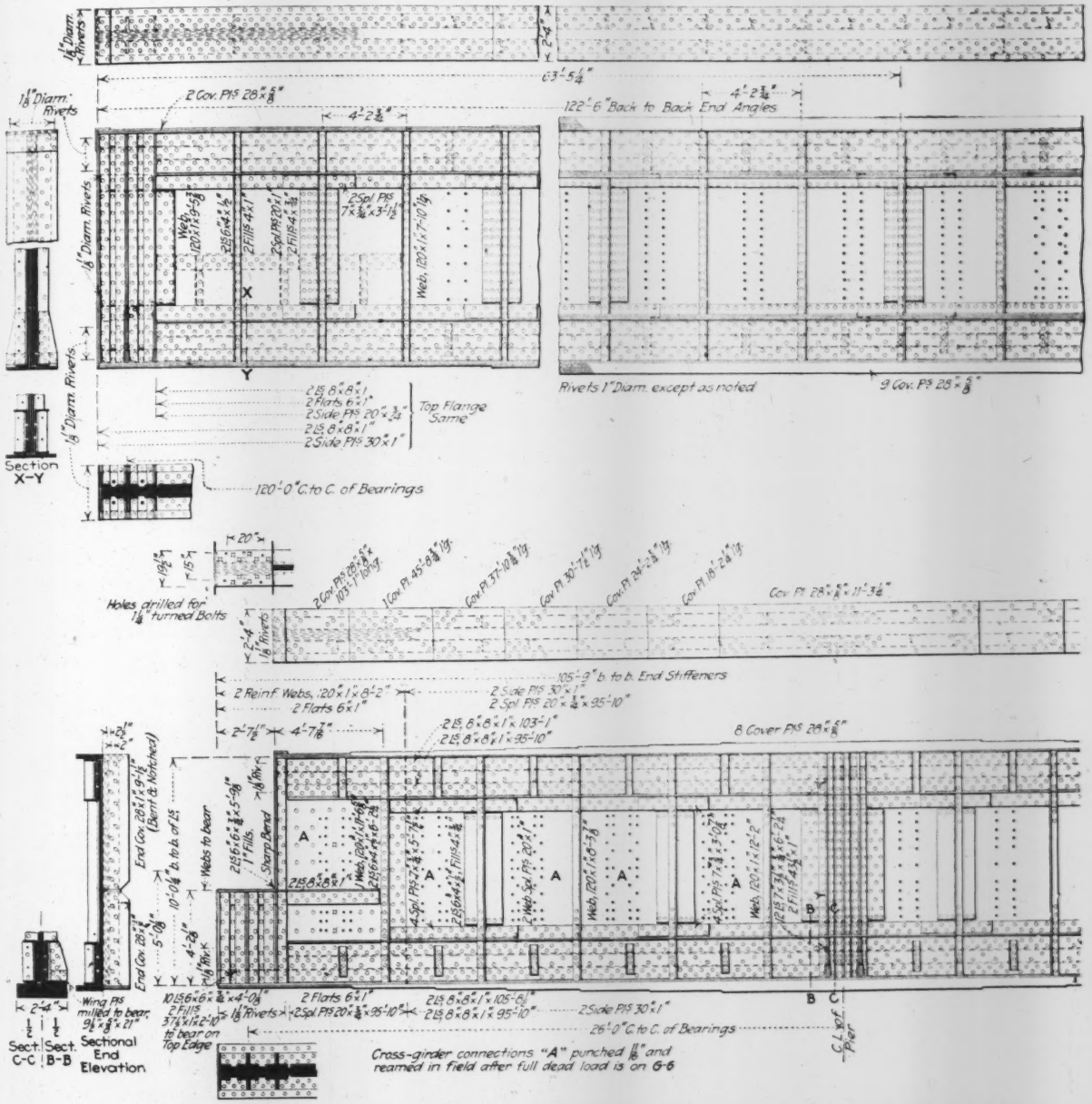

1⅛" Diam. Rivets
63'-5¼"
2 Cov. Pls 28"x⅝"
4'-2¾"
122'-6" Back to Back End Angles
Web, 120"x1"x9'-5⅞"
2 Fills 4"x1"
2 Spl. Pls 20"x⅜"x3'-1½"
Web, 120"x1"x7'-10⅞"
2 Spl. Pls 7"x¾"x3'-1½"
Rivets 1" Diam. except as noted
9 Cov. Pls 28"x⅝"
2 Ls. 8"x8"x1"
2 Flats 6"x1"
2 Side Pls 20"x¾"
2 Ls. 8"x8"x1"
2 Side Pls 30"x1"
Top Flange Same
Section X-Y
120'-0" C. to C. of Bearings
Holes drilled for 1⅛" turned Bolts
105'-9" b. to b. End Stiffeners
2 Reinf. Webs, 120"x1"x8'-2"
2 Flats 6"x1"
2 Side Pls 30"x1"
2 Spl. Pls 20"x¾"x95'-10"
2 Ls. 8"x8"x1"x103'-1"
2 Ls. 8"x8"x1"x95'-10"
8 Cover Pls 28"x⅝"
End Cov. 28"x1"x9'-9⅞"
Webs to bear
Sharp Bend
Wing Pls milled to bear, 9½"x⅝"x21"
Sect. C-C
Sect. B-B
Sectional End Elevation
10 L 6"x6"x⅝"x4'-0⅛"
2 Fills 37¾"x12"x⅝" to bear on Top Edge
2 Flats 6"x1"
2 Spl. Pls 20"x⅜"x95'-10"
2 Side Pls 30"x1"
26'-0" C. to C. of Bearings
Cross-girder connections "A" punched ⅞" and reamed in field after full dead load is on G-6

FIG. 3. DETAILS OF THE 170-TON GIRDER G4 (ABOVE) AND THE CANTILEVER GIRDER G6 (BELOW)

The web is fully spliced at all splices for both moment and shear. The shear splices are made up of vertical 20x1-in. plates each side of the web extending between the side plates. The moment splices are horizontal 20x¾-in. plates between the flange angles and 7x¾-in. plates beneath them. On account of the short distance

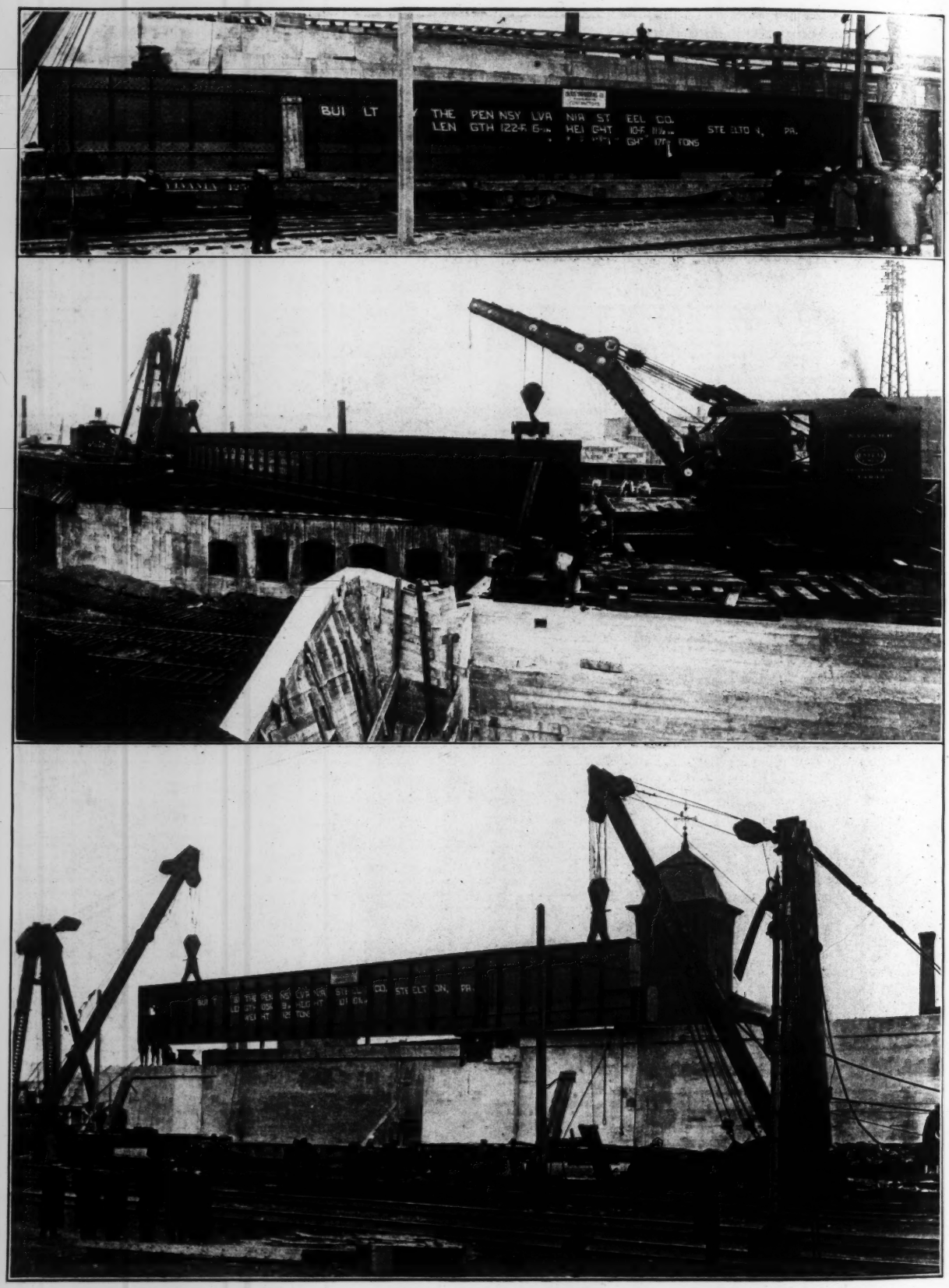


FIG. 4. ERECTION OF HEAVY GIRDER WORK, WORCESTER TRACK ELEVATION, BOSTON & ALBANY R.R.
Upper—The 170-ton girder on cars. Middle—Ready to set girder G7; view shows steel bent incased in concrete.
Lower—Erecting the cantilever G5; both derricks on lower track

between splices, the 20x¾-in. horizontal splice plates were made continuous for nearly the full length of the girder and were used to splice the 30x1-in. side plates. The arrangement of this material is shown by section of the flange, in Fig. 3.

With these heavy flanges the grip of the rivets is 7½ in. through the web, side plates, angles and splice plates at the stiffeners, and 6⅝ in. through the angles and cover plates. On account of this long grip, and also in order to keep the pitch of rivets within reasonable limits, it was decided to make all flange rivets through the web and angles, and through cover plates and angles, 1⅛ in. diameter; throughout the remainder of the girder 1-in. rivets were used.

The Cantilever Girder and Its Anchorage

Cantilever girder *G5* was proportioned with reference to the deflection of the cantilever end. This deflection was kept down to $\frac{3}{16}$ in., of which $\frac{3}{64}$ in. was due to live-load. The maximum unit-stress over the fulcrum point of the top flange was kept below 12,000 lb. per sq.in., in order to limit the deflection. The cantilever end was also stiffened by extending five of the short girders over the east pier and riveting them to it, their opposite ends being anchored to the masonry. The anchorage of the cantilever girder *G5* is made up of channels and plates extending 35 ft. into the abutment. This anchorage is connected to a casting by a pin with an adjustment device consisting of cast wedges resting in a slot cut in the end of the girder.

The westerly pier between the tracks beneath the bridge was limited to a width of 4 ft. The load is evenly distributed over the pier by the cross-girders, except at the ends where the long fascia girders are supported. The pier is made up of steel columns incased in concrete. The columns, spaced 12 ft., support box girders on which the cross-girders rest. At the lower ends the columns are supported on two grillages of girder beams, one above the other, incased in concrete. The grillages for the columns are independent of each other, but the concrete is constructed as a monolith. At the south end of the steel pier the column supporting the ends of the long girders *G3* and *G4* is of unusual size, as the concentration carried by it is about 2,000 tons. The size of the grillages under this column is increased above that for the regular columns. The load is carried into this column through a special shoe consisting of two separate upper castings, one for each girder, supported on a common lower casting by means of heavy forged link bars. This design permits the expansion of both girders over the pier, at the same time anchoring them securely to it.

How the Heavy Girders Were Shipped

One of the first questions that came up with the construction of the heavy girders was the matter of shipment, on account of the unusual dimensions and weights. The Pennsylvania Steel Co., which held the contract for the fabrication and erection of this bridge, obtained the use of two steel well-hole flats of Class FN belonging to the Pennsylvania R.R. These cars consisted of two longitudinal box girders, one at each side of the car, connected at each end by two transverse girders, with a well-hole in the center of the car. The cars have a capacity of 175,000 lb. with the load placed over the trucks, and 150,000 lb. with load placed at center of car.

While these cars could have carried the large girders with the points of support directly over the trucks and not exceeded their capacity, the axle concentrations would have been too large for shipment over the lines interested. On the other hand, with the points of support in the center between trucks, the capacity of the cars would have been exceeded. The Pennsylvania Steel Co. therefore framed two new cross-girders in the well-holes, well back toward each truck, and between them two new longitudinal girders. With this alteration the girders were supported in the center of the car. The usual shores and bolsters for shipping large girders were provided, with special arrangements made for keeping the chafing plates between upper and lower bolsters well lubricated, by the use of compression oil cups. After each shipment the chafing plates were thoroughly cleaned and the oil cups refilled.

The girders were routed via Pennsylvania R.R. to Wilkesbarre, Penn., Delaware & Hudson Co. to Albany, N. Y., and Boston & Albany R.R. to Worcester, Mass.

The average time from date of shipment of a girder to date of its erection was five days. The average time between date of shipment of one girder until date of return of cars and shipment of next was eleven days. These two cars were the only ones which the Pennsylvania Steel Co. was able to obtain on which to ship the girders, and it was necessary to have the girders arrive at the bridge site in the order needed for erection, so that they could be taken care of on alternate Sundays. The distance involved in shipment was 487 mi. each way.

Engineers and Contractors

The erection of the superstructure was started Jan. 7, 1912, by the placing of the 170-ton girder *G4*, and was completed May 3, 1912. The erection of the plate-girder work was completed Feb. 29, 1912. The erection of the truss span was begun Mar. 4, 1912, and completed May 3, 1912.

The Pennsylvania Steel Co., Steelton, Penn., as contractor for the fabrication and erection of the steelwork, sublet the erection to the Lucius Engineering Co., of Pittsburgh, Penn.

The bridge was designed and built under the direction of the Engineering Department of the Boston & Albany R.R.

The City of New York Expended $192,877,000 in 1915, and during the current year will expend $194,981,000, according to figures made public by Comptroller Prendergast. Adding to this sum the state taxes on residents of the city, which are assessed and collected by the city, the total taxes paid in New York City this year for municipal, county and state government will be $212,956,000. The distribution of the money raised for various purposes is shown by the following table, which is compiled to indicate how the sum of $100 paid in taxes will be distributed in 1916:

Interest on city debt	$21.55
Payments on principal of city debt	10.87
Total for city debt	$32.42
Public education, including colleges and libraries	21.81
Protection of life and property—police and fire departments, street lighting and state militia	15.61
Health and sanitation, including street cleaning	8.40
Public charities and charitable institutions	5.12
Courts, prosecuting attorneys, coroners, sheriffs, etc.	4.97
Maintaining streets, paving, sewers, public buildings, etc.	3.69
Docks, ferries and bridges	1.15
Public amusements, parks, museums, etc.	1.61
All other expenses	5.22

Irrigation Headworks Repair and Dam Failure

By W. G. Bligh*

SYNOPSIS—Reconstruction of the headworks of the canal for the Southern Alberta Land and Irrigation Co. on Bow River, in Alberta. Failure described in earlier issue of "Engineering News." Description of more recent failure of part of the main dam or weir at the headworks, a concrete structure on porous foundations.

An article by the writer in *Engineering News*, Feb. 6, 1913, described the failure of the headworks of a canal, the name and location of which were then for certain reasons withheld. The canal in question is that of the Southern Alberta Land and Irrigation Co. near Medicine Hat, Alta., a general description of which was given in *Engineering News*, Aug. 13, 1914, p. 354. During the two years and over that have elapsed since the destruction of the intake and weir sluices, the canal works have passed under new professional direction, the headworks in question have been rebuilt and other works of considerable

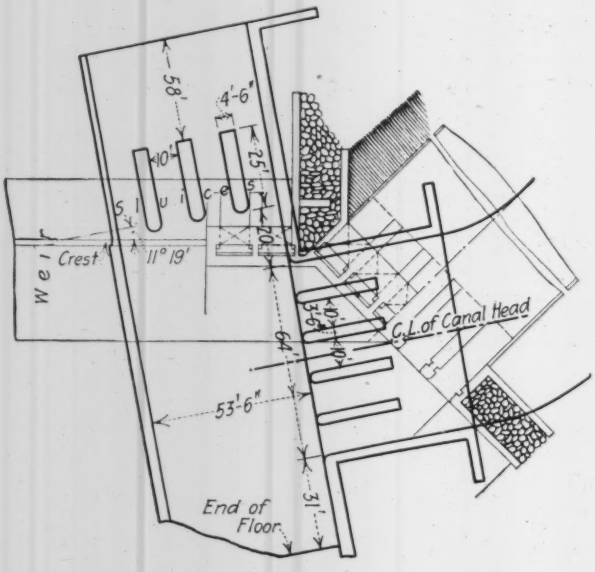


FIG. 1. ORIGINAL AND PRESENT LAYOUT OF HEADWORKS AND WEIR SLUICES, NAMAKA DAM, ALBERTA
Original shown light, present shown heavy

magnitude have been constructed. Meanwhile a second catastrophe occurred in June of last year, when a record flood in the Bow River caused the collapse of the main dam, a failure incidentally predicted in the article alluded to. In the present article it is proposed to deal first with the new intake and weir sluices and then with the failure of the weir itself. It is known as the Namaka Dam.

The destroyed headworks were rebuilt on very nearly the same site as before, but the faulty alignment of the canal head relative to the sluices, to which point attention was drawn in the previous article, is corrected in the new work, the intake being now located at right angles to the weir sluices. Fig. 1 shows the relative positions of the old and new works, and Fig. 2 is a complete plan of the whole new headworks. It will be noticed that the sluices are aligned at an angle of 11° 19′, set inward from the axis of the weir. This arrangement reduces the curvature required in the earth channel of the canal to effect a junction with the existing cut.

The waterway provided for the new intake is the same as before—that is, five openings of 10 ft. each. The opening of the weir sluices has been increased from two to four spans of 10 ft. each. It would undoubtedly have been a better arrangement to have adopted two openings of 20 ft. for the weir sluices for the reason that the less obstruction offered in the way of piers the greater will be their scouring capacity, but considerations of economy in first cost dominated all others in the design of the new headworks and the retention of the original spans of 10 ft. enabled the Stoney gates and their appurtenances, which were salvaged from the old wreck, to be utilized. For the closure of the canal head the old gates, which have a depth of only 8 ft., are not very suitable. Under existing conditions the adoption of double draw gates working in separate grooves, thus enabling flood water to be drawn off over the lower leaf, would seem to be the best possible installation. These gates are usually mounted on small antifriction wheels, which is a much simpler arrangement than Stoney roller trains. In the present instance the most economical means of regulation, that of wooden vertical needles, had to be adopted. These bear against a raised sill at the bottom and a concrete slab at the top.

The excellent arrangements adopted for the effective scour of heavy deposit in front of the canal intake are shown in Fig. 2. The sill of the intake is raised 5 ft. above its floor level and above that of the scouring-sluice approach channel. This arrangement admits of the accumulation of silt and boulders to a depth of over 5 ft. in the scouring channel, which would otherwise find its way into the canal but which now can be washed out when desired by opening the weir sluice gates. This channel is cut off from the weir by divide walls below as well as above the sluice regulator, which cause concentration of the current, thus rendering it more effective. The channel is paved with boulder masonry, which construction is cheaper than concrete.

With regard to uplift and subpercolation, neglect of which matters caused the former disaster, the sluice head is amply protected by the long floor in its rear. The value of L, or the effective length of percolation, is 206 ft., while that of H cannot exceed 10 or at the most 12 ft. C, or the ratio L to H, comes to 17, whereas a value of 6 is considered sufficient for a boulder bed such as that of the Bow River. The uplift on the sluice head and on the solid floor beyond it is amply cared for by the weight of the structure itself and the thickness given to the floor. The canal head has $L = 110$ ft. and on the improbable assumption that the canal is completely closed during the highest floods, H will be 18 ft., making $C = 6$, which is

*26 Cornish Road, Toronto, Ont.

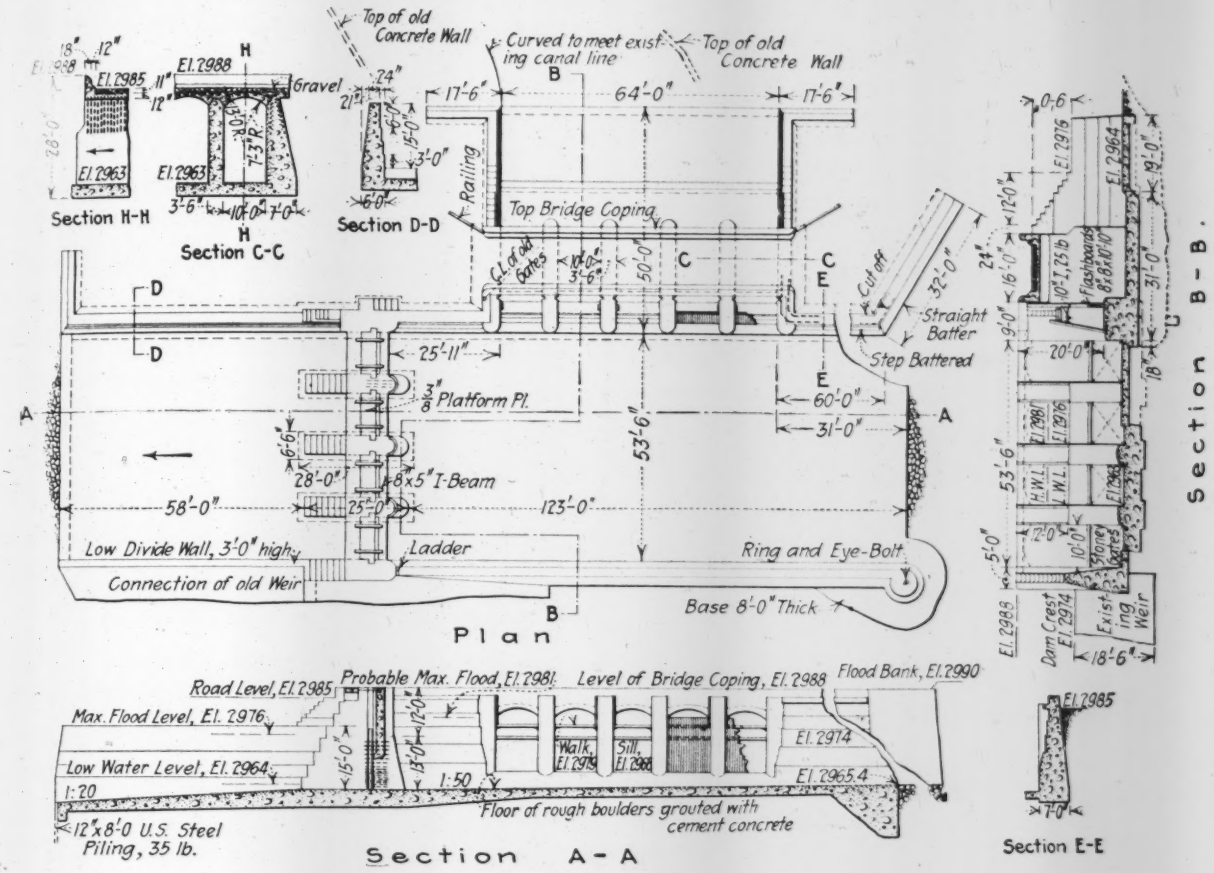


FIG. 2. DETAILS OF NEW HEADWORKS AT NAMAKA DAM

just sufficient. In consideration of uplift on the floor beyond the canal head, the floor is carried down to solid ground and should therefore be free from any hydrostatic pressure; in case any did exist, the 10 ft. thickness of this floor is more than ample.

This work successfully withstood the record flood of June, 1915, which wrecked the weir. In all works which are founded on the porous material that composes the bed of a river and which are also exposed to the dynamic action due to the momentum of floods of high velocity, weight is recognized as a desideratum; for this reason light reinforced-concrete construction is not suitable. Consequently in this design reinforcement has been sparingly used, the thickness given to the piers and walls being such as to render it unnecessary. Steel reinforcement is used in the thin breast wall of the weir sluices and as ties in the arches of the intake and a few other places. A highway bridge is provided across the canal head with proper concrete curbs and parapets, a refreshing contrast to the sorry makeshifts too often adopted for cross-communication. It is noticeable that sheet piling is nowhere made use of; the reason for this is that the river bed contains large-sized hidden boulders that render the driving of sheet piling impracticable except for shallow depths.

Failure of Dam on Porous Foundation

The diversion weir across the Bow River is composed of two lengths, each about 500 ft., separated by an island. The main current of the river is on the south section—that adjoining the canal head. It was in this part that the failure took place. In the article of Feb. 6, 1913, the faults inherent in the design of the section were commented on and it was stated that it only needed either a very high flood or a very low stage of the river to bring about a catastrophe, the correctness of which forecast has now been definitely proved. The main fault in the design consisted in stepping up the foundations of the weir in conformity with the profile of the river bed. This procedure, though suitable enough for a foundation of solid rock, is clearly inapplicable where the river bed consists of loose material liable to erosion. In a river

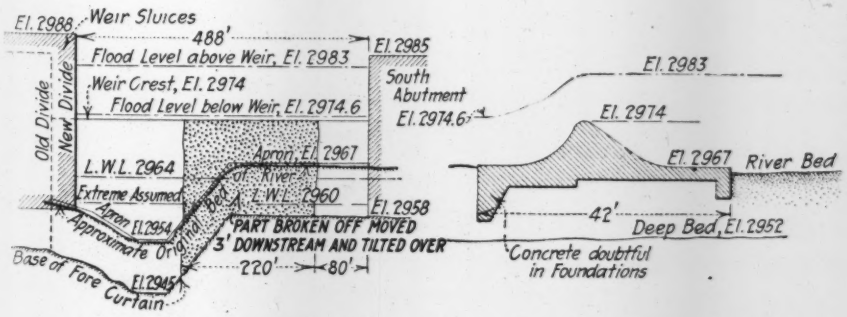


FIG. 3. SECTIONS THROUGH MAIN DAM AT HEAD OF IRRIGATION CANAL

channel in its natural state one part of the bed is deeper than the rest and in this the main current flows. When, however, a level-crested artificial obstruction, as a diversion weir, is thrown across the river, the previous inequalities in the current are obliterated and the tendency of the falling water is to disintegrate and wash away the higher parts of the bed, which are the most exposed and the least protected by a deep stratum of water. Thus the foundation of any overfall dam built on a loose material, as sand, gravel or boulders, must necessarily be at one low level throughout. The violation of this self-evident axiom, combined with insufficient base length, was the cause of the failure.

Fig. 3 is a longitudinal section of the south weir drawn to an exaggerated scale, and adjoining is the minimum section of the weir, which extends for nearly half the length of the work. At the north end the relative positions of the old and new scouring sluices are shown. The flood rose to El. 2983, 9 ft. above the crest of the weir, while the tail water stood at 0.6 ft. above it. The hydrostatic conditions were therefore most unfavorable. The whole of the weir being submerged, its effective weight was reduced by flotation by nearly one-half at a time when a violent flood 9 ft. deep was pouring over the crest. This torrent must have speedily scoured out the unprotected river bed in front of the short fore-apron, in the meantime the hydraulic gradient being reduced to about 1 in 3.8, undermining by the undercurrent had set in and was further assisted by the pressure of the flood waters acting against the weakened resisting ability of the weir. The inevitable result was that the portion most affected, 220 ft. long, sank and fell over, breaking away from the rest, as shown on Fig. 3.

The broken part settled 3 ft. at the time of the accident and swung several feet downstream, toppling forward very much in the same manner as the case of the canal intake. The probability is that the whole of the south weir will have to be demolished and a properly designed hollow-slab buttress dam substituted.

The new headworks were designed by R. G. Kennedy, formerly Chief Engineer of Irrigation Works in the Punjab and well known to the profession from his researches in the matter of the silt-carrying capacity of canals. Mr. Kennedy, now resident at Sidney, B. C., is Consulting Engineer to the company, while the Chief Engineer in active charge of the whole project is D. M. Hays, an American engineer who was appointed when the staff was reorganized after the first failure in 1913.

Two Buildings Carried Over a Railway Tunnel

To carry a four-story building over the tunnel of the Panhandle Route under Pittsburgh, Penn., a steel and concrete box was constructed around and above the tunnel masonry during the past summer. This construction not only provides in safe and substantial manner for the wall, floor and column loads of the building, but makes possible a future widening of the tunnel. The new concrete walls or piers which support the building are now outside the tunnel masonry, but in case of such widening they become the tunnel walls and the old walls and arch inside would be removed.

The tunnel, built during 1863-1865 by the Pennsylvania R.R., is a double-track structure 1,490 ft. long, composed of rough masonry walls and an arch partly of stone block and partly of five rings of brick. It is not far below ground surface, but the original depth of cover (ranging up to 30 ft.) has been greatly reduced by successive street-lowering work done by the city. At Sixth Ave. there was formerly 15 to 20 ft. of cover, while now there is only 7 ft. An old two-story building on the east line of Sixth Ave. rested on shallow footings in the backfill earth over the tunnel—the tunnel having been built cut-and-cover at this point. In replacing it by a new four-story building, new foundations had to be provided not resting on or over the arch.

The section, Fig. 1, shows the design of the new supporting structure, comprising heavy concrete walls along either side of the tunnel, just outside the old tunnel walls, and a roof of steel girders and beams with concrete filling. The framing of these beams is affected by the sharp skew of the tunnel with respect to the street line, as shown by the plan, Fig. 2. Heavy plate girders span from wall to wall on the side lines of the lot, to carry the side walls of the building, and another girder is framed into one of these to carry the front wall. The roof beams vary in size and spacing to provide for columns of the building. Two of them are 27-in. box girders. The roof had to be shallow to save headroom in the basement of the building.

The concrete footing walls at their ends are enlarged into piers capped with grillages to take the reactions of the main girders. Distributing grillages along the top of the walls take the load of the roof beams.

This carrying structure was built in excavation from the surface. Each wall was constructed in a sheeted trench sunk alongside the tunnel wall, with braces across the trench to take the full arch thrust. The bottom

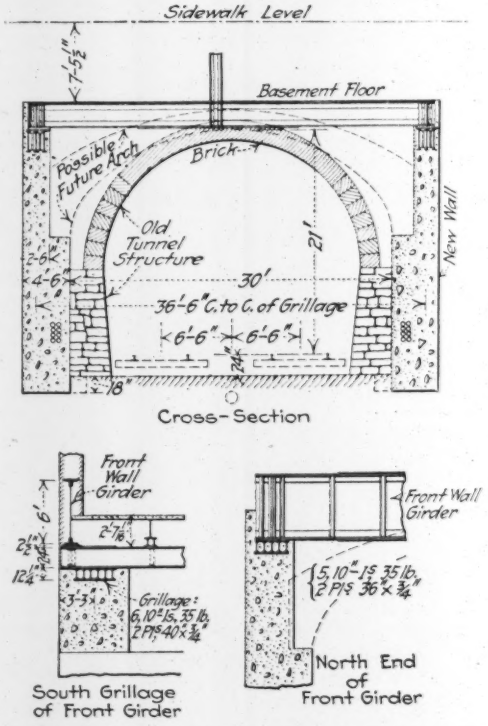


FIG. 1. SECTION OF PITTSBURGH TUNNEL WITH STRUCTURE TO CARRY BUILDING

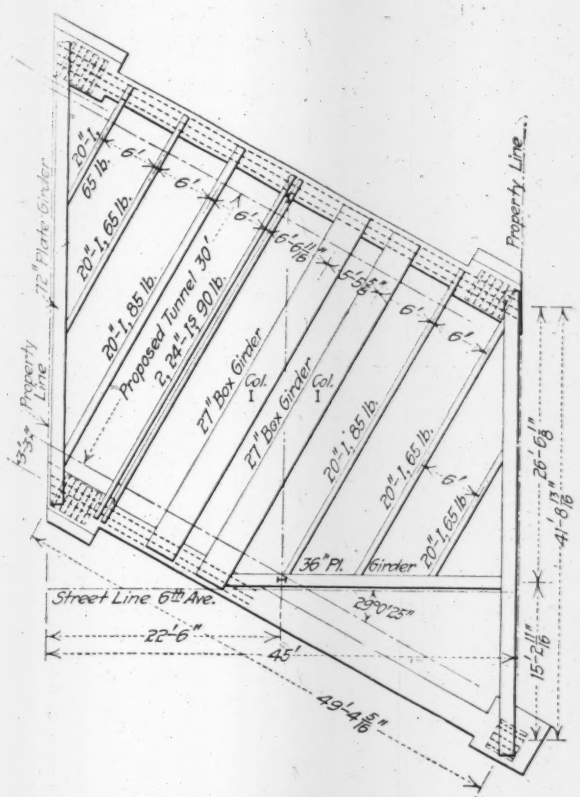


FIG. 2. PLAN OF ROOF FRAMING OVER TUNNEL TO CARRY WERDER BUILDING

of the tunnel is in hard blue limestone, and the masonry of the old walls is laid up on this without widened footings. The new walls were carried down 18 in. lower, and for this purpose the rock was chipped out by hand, as blasting might have disturbed the old masonry.

Placing the roof steel and concreting it was an ordinary operation. The roof constitutes the basement floor of the building.

The John F. Casey Co. did the work for the Pennsylvania Lines, Southwest System. W. C. Cushing, Chief Engineer, Maintenance of Way, directed the work; Frank L. Miller was in charge on the ground. The work was begun in July and completed in September, 1915.

The site of the new Gazette-Times Building, corner of Strawberry Way and Dante Alley, projects over the tunnel from one side a distance of about 14 ft. For this case another method of support was adopted—namely, cantilevering out over the tunnel, so as to keep the building independent of the tunnel structure. C. O. Gilbert was engineer for the work, acting for Edward B. Lee and J. P. Piper, associated architects of the building.

At the projecting corner a large cantilever girder supported on piers and anchored down carries the forward columns. There are two other cantilevers, with smaller amounts of projection. The girders occur at press-room level only and carry columns which support normal floor framing at the tiers above.

The support of the large cantilever is a concrete pier carried down to the level of the tunnel floor. The girder is twin, with flange tie-plates. The rear column, which furnishes the anchorage, does not pass through the girder, but the upper section starts from the top flange of the girder. The column below the girder takes the uplift by way of an anchor plate riveted to the back of the end stiffeners of the girder. As this column has not enough dead-load to balance full live-load on the front column, it is anchored down to its concrete footing pier, and this pier is made larger than otherwise required and is belled out in the rock.

The Fort Pitt Bridge Works built the steelwork of the Gazette-Times Building.

City Paving Compared with Contract Work

The cost of street work done in St. Paul, Minn., by city forces on a number of jobs shows a considerable saving over contractor's bids, according to figures given recently by Adolph F. Meyer, Consulting Engineer, St. Paul, in the "Bulletin" of the Civil Engineers Society of St. Paul. The table is reproduced herewith. It shows lower cost of work by the city in nearly every individual instance; for the total of all the jobs in the table the city work is about 10% cheaper.

The table of contract figures is not the bid price itself, but the bid price plus 3%, the author of the article having added this to cover the cost of inspection. Were the 3% not added, the showing of the table would be but slightly changed. Mr. Meyer concludes: "The experience of 1915 shows that on the whole there is not likely to be any saving to the city through the letting of paving work by contract instead of doing it by force account, unless the lowest bid received is at least 7% less than the engineer's estimate."

COST OF FORCE-ACCOUNT PAVING, ST. PAUL, MINN., 1915

Street	Actual Cost	Engineer's Estimated Cost	Contractor's Bid Price	Saving on Engineer's Estimate	Saving on Contractor's Bid Price	Percentages: Engineer's Estimated Cost Is Higher Than Actual Cost, %	Percentages: Contractor's Bid Price Is Higher Than Actual Cost, %
Fillmore Av.	$10,056.06	$11,441.00	$11,401.48	.....	$1,345.42	13.78	13.38
Robert St.	11,732.29	12,266.75	14,445.50	.....	2,713.21	4.6	23.00
Fairfield Ave.	25,570.42	28,112.00	28,461.99	.....	2,891.57	9.9	11.3
S. Smith Av.	34,265.98	38,012.00	37,530.00	.....	3,264.02	11.0	9.5
Fairview Av.	3,825.78	4,121.00	4,793.60	.....	967.82	7.7	25.3
Linwood Pl.	3,375.54	3,485.68	4,512.43	.....	1,136.89	3.2	33.0
Wabasha St. Winnifred St. Ohio St. George St.	42,101.03	45,734.77	50,565.45	.....	8,464.42	8.6	20.1
3rd St.	3,951.18	3,839.13	4,031.55	.....	80.37	—3.0	2.0
Robert St.	7,016.75	7,460.00	7,236.78	.....	220.03	6.3	3.1
Summit Av.	3,364.85	4,000.00	3,799.67	.....	434.82	19.2	13.0
Plum St.	1,687.58	1,800.00	1,859.15	.....	171.57	6.6	10.2
Congress St. Isabel St. Concord St.	15,710.32	17,394.52	18,227.39	.....	2,517.07	10.7	16.0
Dayton Av.	17,581.89	20,817.00	20,208.60	.....	2,626.71	18.4	14.9
N. Smith Av.	57,636.92	61,228.88	63,270.72	.....	5,633.80	6.23	9.78
Marshall Av.	96,253.82	107,247.00	104,025.88	.....	7,772.06	11.4	8.08
Total	$334,130.41	$366,959.73	$374,370.19	$32,830.12	$40,239.78	9.83	12.04

State-Wide Clean-Up of Labor Camps in California

By J. J. Rosenthal*

SYNOPSIS—Through the efforts of the Commission of Immigration and Housing many labor camps have been reconstructed along sanitary lines and nearly 1,500 camps housing almost 100,000 people have been inspected.

On Aug. 3, 1913, a riot occurred on the Durst ranch near Wheatland, Yuba County, Calif., resulting in the killing of two hop pickers and two police officials. Upon investigation by state and Federal officials, it was found that the primary causes of the discontent in the ranks of the hop pickers, leading up to the riot and bloodshed, were the insanitary conditions of the camp. The writer, who was one of the investigators in the field, obtained affidavits testifying to the following facts:

In 1913, the Durst Brothers, by means of widespread advertising throughout the State of California, succeeded in assembling a polyglot body of 3,000 pickers, about half of whom were women and children. At the time of the riot there were about 2,800 pickers in the camp. When

*Lately Chief Sanitary Engineer, Commission of Immigration and Housing of California; now Safety Engineer, California Industrial Accident Commission, 525 Market St., San Francisco, Calif.

PORTIONS OF OLD AND NEW HOP PICKERS' CAMP, DURST BROTHERS' RANCH, NEAR WHEATLAND, CALIF.
Upper—Hobo camp, 1913; shelters of gunny sack, supported on brushwood. Lower—Model camp, 1914, after plans by Commission of Immigration and Housing

CAMPING IN CROWDED QUARTERS WITH ALL OUTDOORS AVAILABLE.

(Left)—A row of 4x6-ft. inhuman stalls in a bunkhouse where 15 to 20 laborers slept; window at rear, only means of ventilation, shut down. (Right)—Two 10x26-ft. triple-deck bunk cars, each occupied by 19 persons, affording 95 cu.ft. of air space each. This was a state highway construction camp until corrected.

this conglomerate body arrived at the Durst ranch, it found a desolate sun-baked field, without shelter from the burning sun of the Sacramento Valley. There were only a few tents which the Durst Brothers rented at 75c. per week; but the majority had to construct rude shelters made of poles and gunny sacks, called "pig pens," while many were compelled to sleep in the open piles of hop vines and straw.

From reports and investigations there were not more than 11 toilets, of the crudest sort, for this number of people, used indiscriminately by both sexes.

There was a scarcity of drinking water on account of the dry season and some of the wells were pumped dry, while others became infected from the surface water that drained back from stagnant pools and the toilets which were in close proximity. Under such deplorable, insanitary conditions, sickness prevailed in the nature of typhoid, dysentery and malarial fever.

While the wage scale and other factors contributed to the feeling of discontent, the paramount cause of the protest of the pickers seemed to be the inadequate and the insanitary conditions, under which the hop pickers were compelled to live.

The Commission of Immigration and Housing decided that these insanitary conditions constituted an aggravation of industrial warfare, and that they could and should be changed at once. It was ascertained that Durst's camp was no exception; for similar conditions existed in other labor camps throughout California, and it was decided that a *state-wide clean-up* campaign was indispensable. This task really came under the jurisdiction of the State Board of Health, but that body was without funds to do the work of inspection and of remedying the conditions. Consequently the Commission of Immigration and Housing, with the consent of the State Board of Health, decided to enter upon this undertaking, particularly because one-half of the population of the labor camps of the state is made up of immigrants.

The existing state law pertaining to the housing of labor camps was found to be inadequate and inefficient. It merely stated in general terms that tents, sleeping quarters, and the grounds about camps must be kept clean. No way was provided for ascertaining the conditions of the camps except through the occasional complaint of a laborer fearless enough to risk incurring the displeasure of his employer. Nor did the statute attempt to set forward a minimum standard of housing and sanitary conditions, which can readily be seen in the following:

Section I. In or at any camp where five or more persons are employed, the bunk houses, tents and other sleeping places of such employees shall be kept in a cleanly state and free from vermin and matter of an infectious and contagious nature, and the grounds around such bunk houses, tents or other sleeping places shall be kept clean and free from accumulations of dirt, filth, garbage and other deleterious matter.

Section II. Every bunk house, tent or other sleeping place used for the purpose of a lodging or sleeping apartment in such camp shall contain sufficient air space to insure an adequate supply of fresh air for each person occupying such bunk house, tent or other sleeping place. The bunks or beds shall be made of iron, canvas or other sanitary material and shall be so constructed as to afford reasonable comfort to the persons occupying such bunks or beds.

TWO TYPES OF IMPROVED CAMPS FOR CALIFORNIA LABORERS

(Left)—Permanent model bunkhouse for farm laborers, with separate well-ventilated room for each man and large 10-shower bathroom. (Right)—Model camp for laborers in oil fields. One of the buildings contains six shower baths and other washing facilities.

Owing to these weaknesses in the foregoing law, the Commission of Immigration and Housing had first to work out a minimum standard of living conditions in labor camps. This minimum standard had to be sufficient to insure results, but not so expensive and so impracticable as to deter employers of labor camps from adopting it, since employers had to be persuaded rather than compelled by law to meet the improvements suggested.

In order that the Commission of Immigration and Housing might be sure of its ground it decided to remodel a camp and make it sanitary, thus putting theory into actual practice. This first experiment of camp sanitation was made at Shingle Springs, El Dorado County, where 135 men were employed by the state on highway construction. The Chief Sanitary Engineer of the Commission planned a model camp, and installed latrines, shower baths, fly-proof cooking and dining tents, model sleeping quarters, garbage receptacles, and incinerators, and other modern improvements at a minimum cost. The results were very satisfactory and a set of sanitation rules was drawn up. These rules and practical suggestions for carrying them out were compiled in a small pamphlet of 7 pages which met with the approval of the State Board of Health.

These pamphlets were distributed among camp owners throughout the state. The Chief Sanitary Engineer and a force of inspectors were sent out. They found that most of the camps were below the minimum standard, but found that the camp owners were willing to coöperate to improve the conditions of their employees, but did not know how to go about the work to make improvements without plans and instructions. Consequently it was deemed advisable to prepare a larger and more comprehensive booklet containing detailed plans, bills of materials, and specifications of camp facilities, taking Los Angeles, Fresno, San Francisco and Sacramento as central points of market price of materials and labor.

Believing that much of the abuse arose more through carelessness and ignorance on the part of those operating labor camps, than because of any disposition to avoid the law, the whole spirit of our efforts was coöperation and advice rather than compulsion.

A pamphlet containing 56 pages and 43 illustrations was prepared and more than 6,500 copies of it have been distributed since it was published in July, 1914. In this booklet it is pointed out that a sanitary camp means an increase in the willingness and efficiency of the laborer, and that it is in the employer's own interest as well as that of humanity to have a sanitary and livable camp. Every phase of camp sanitation and housing is dealt with. Blueprints and sketches of camp structures have been furnished when desired. The suggestions cover the site of camp with advice as to choosing high ground, layout of camp, water-supply, construction of tents, buildings and bunks; screening, ventilation, etc.; kitchens and eating houses, with suggestions for keeping food; disposal of garbage and refuse by means of incinerators; fly-proof toilets; with complete plans and specifications for bathing facilities, sleeping quarters, with proper drainage, and how to avoid camp sicknesses that come from flies, mosquitoes, manure piles, and other causes.

The pamphlet met with the most gratifying response from camp owners throughout California, and hundreds of commendatory letters were received.

Active camp inspection was begun by the Commission on Apr. 1, 1914. Inspectors are sent out into the field, who report their findings to the office on blanks, which give every detail of the camps inspected, including the number and nationality of men employed, permanent or temporary, skilled or unskilled labor, living conditions, sanitary conditions, toilets, bathing and washing facilities, etc. A letter of instructions and a pamphlet are then promptly mailed from the main office to each owner or superintendent of the labor camp, calling attention to the special needs of his camp, and inviting correspondence with the office of the Commission of Immigration and Housing if any difficulty arises in trying to make his camp conform to the requirements.

Up to Jan. 1, 1916, 1,346 camps, housing 91,328 persons, were inspected, 858 of these camps have been reinspected, and 75% have come up to the standard set by the Commission, while the remainder have made some of the suggested improvements.

Some of the conditions before and after the work of the Commission was begun are shown by the accompanying views.

Storing and Pumping Sewage, Manchester, Mass.

By Charles W. Sherman*

The town of Manchester, Mass., is situated on the southerly side of Cape Ann, with the thickly settled portion of the town at the head of Manchester Harbor, a narrow bay about 1¼ mi. long. The area served by the sewers is about a mile square, and the most congested portion of it is but little above the level of high tide. Some of the sewers are laid on flat grades, and the highest practicable invert elevation of the sewers at the location selected for a pumping station upon the shore of the harbor was —1.75, datum being mean low water. As the range of tide averages about 10 ft. and extreme tides rise to about El. 13, it is evident that a gravity outlet would have involved serious backing up into the sewers at each high tide, even if it were allowable to discharge sewage into the harbor. The point selected for discharge was, however, in deep water off the mouth of the harbor, at a distance of some 8,500 ft. from the pumping station and where there is a depth of about 40 ft. at low water. It is believed that many years will elapse before the quantity of sewage to be produced in Manchester—a town of 2,945 inhabitants in 1915—can be noticeable at the outlet.

As the amount of sewage to be cared for is not great and as it is not desirable to pump continuously, storage tanks were necessary; and as these tanks have their tops more than 10 ft. below the level of extreme high water, it is obvious that stability against floating when empty had to be taken into consideration, as well as strength to carry the considerable earth-fill (about 12 ft.) over the roof. These conditions resulted in some details of design not usual in structures of this character.

The subterranean structure consists essentially of three parts: (1) a screen chamber, (2) the two storage tanks, (3) a dry well for the pumps—all as shown in detail by the accompanying plans and sections.

*Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

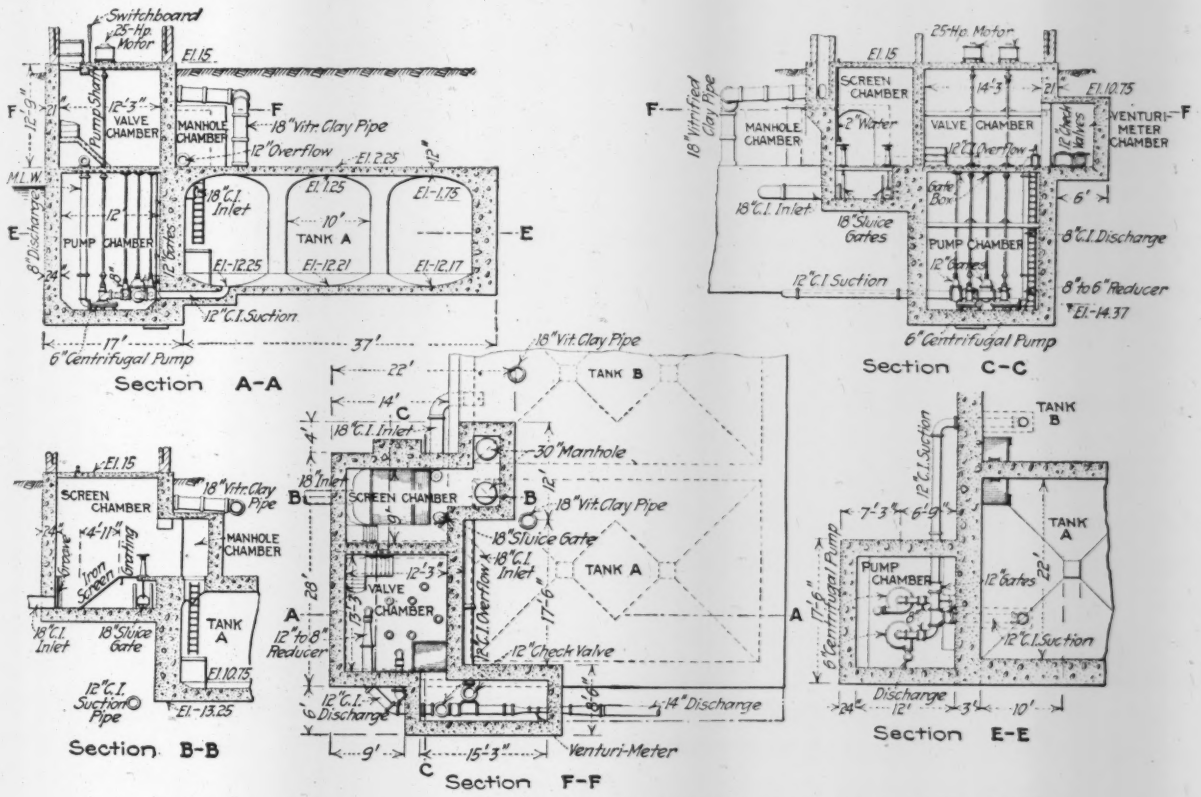
The screen chamber, which is reached by an iron stairway from one end of the brick superstructure, contains an inclined rack of iron bars, and gates by which the flow of sewage may be shut off from either tank if desired. The entrance to the tanks is from the screen chamber by manholes in the roofs of the tanks. A portion of the floor of the screen chamber is of iron bars, to facilitate draining the screenings. There is an overflow connection from the screen chamber into the force main, so that if the pumps should be out of service the sewage would overflow after reaching El. 2.50, except when the tide is at a higher elevation.

The storage tanks are two in number, either or both of which may be used. Each tank has an available capacity of about 55,000 gal. The groined-arch type of construction was adopted for both roof and floor. Each bay has a clear span of 10 ft., and the piers are 2 ft. square. The rise of the arch is 3 ft. and the thickness of roof 12 in. Each tank consists of three bays in length by two in breadth and therefore measures 22x34 ft. in plan, the effective depth being about 11 ft. and the columns 9 ft. high. The division wall between the tanks is 2 ft. in thickness, and the side walls are 3 ft. thick.

Iron ladders are provided in the manholes and also iron platforms from which it is possible to wash down the walls of the tanks by a hose stream. Since the volume of air displaced as the tanks fill is considerable and it was not desirable that this should be forced up through the manholes and the screen chamber, a chimney containing a large ventilating flue (18x36 in.) was built at one end of the superstructure; and an 18-in. vitrified pipe flue from each of the tanks leads to the bottom of the chimney.

The pump chamber is a dry well at the end of the tanks and adjoining the screen chamber. The pumps are set below the bottom of the tanks; and as shown in the plan, either or both of the pumps can draw from either or both of the tanks. Leakage or condensation in the dry well drains to a small sump, from which it can be lifted by the main pumps by opening a 1½-in. angle valve operated from the floor above.

The floor above the pump chamber forms a room called the valve chamber. Here are located the gate valves on the discharge pipes, and all of the valves on the suction connections are operated from this floor by extension stems reaching to gate boxes set in the floor. An iron ladder extends from this floor down into the pump chamber. A small chamber leading out of the valve chamber contains the check valves on the main discharge and overflow pipes and also the venturi meter. The pumps are electrically driven, the motors being in the superstructure.



DETAILS OF SEWAGE STORAGE TANKS AND PUMPING STATION, MANCHESTER, MASS.

The pumps are of the ordinary type of open impeller vertical centrifugal pump and were furnished by the Lawrence Machine Co.

The structure was built in 1914 by the Charles R. Gow Co., contractor, the price being $15,300, including superstructure, but not including cement, bricks or ironwork, which were furnished by the town.

The Sewer Commissioners under whose direction this work was carried out are Oliver T. Roberts, George E. Cabot and James Hoare. The Chief Engineer was Raymond C. Allen, of Manchester. Desmond Fitz Gerald, of Brookline, was Consulting Engineer, and the storage tanks and pump well were designed under his direction in the office of Metcalf & Eddy, of Boston.

Concrete Viaduct with Special Expansion Provisions

By Charles W. Martin*

The Jefferson Ave. viaduct built by the City of St. Louis, Mo.—a long reinforced-concrete viaduct made up of a series of girder-and-slab spans—is somewhat novel in that expansion is provided by dividing some of the pedestals in two by a vertical opening. The viaduct is otherwise distinguished by the method of placing the coping and by the design of the railing and the light posts.

The viaduct, which replaces an old one of steel, is 1,255 ft. long, extending from Scott Ave. to Chouteau Ave., and spans Papin St. and the tracks of the Missouri Pacific, Wabash and Frisco railways. It is 60 ft. wide and provides a 40-ft. roadway and two 10-ft. walks.

The bridge structure over the tracks consists of 14 spans, varying in length from 31 to 45 ft., with two end abutments and 13 piers, and skewed to meet track conditions. In general, each pier consists essentially of three vertical shafts 2x8 ft. in plan and resting on a transverse foundation slab. The principal structural elements of each of the 14 span units of the superstructure are 10 longitudinal stringers, two transverse end beams and a 12-in. slab. The two abutting end beams of adjoining spans are, save at expansion joints, keyed together over the piers with a saw-tooth arrangement of the transverse construction joints. No negative reinforcement is extended across this joint, as it was considered that the character of the foundation precluded all other than a simple beam-type deck-span design. This is shown in the upper detail in Fig. 3.

*Engineer, Bridge Division, City Hall, St. Louis.

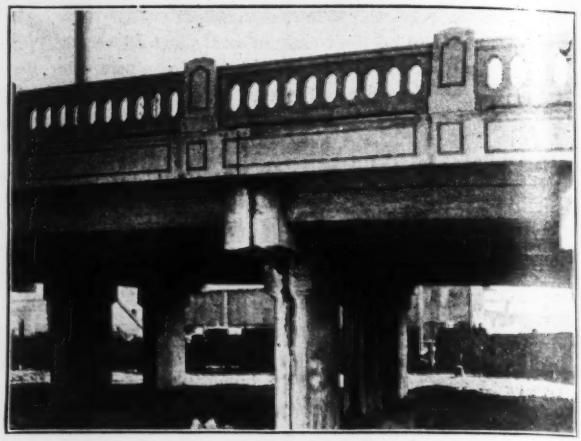


FIG. 2. ONE OF THE SPLIT PIERS TO TAKE CARE OF EXPANSION

The bridge over Papin St. has a center roadway span of 25 ft. and two 8-ft. sidewalk spans that are supported by two abutments and two lines of piers along the curbs.

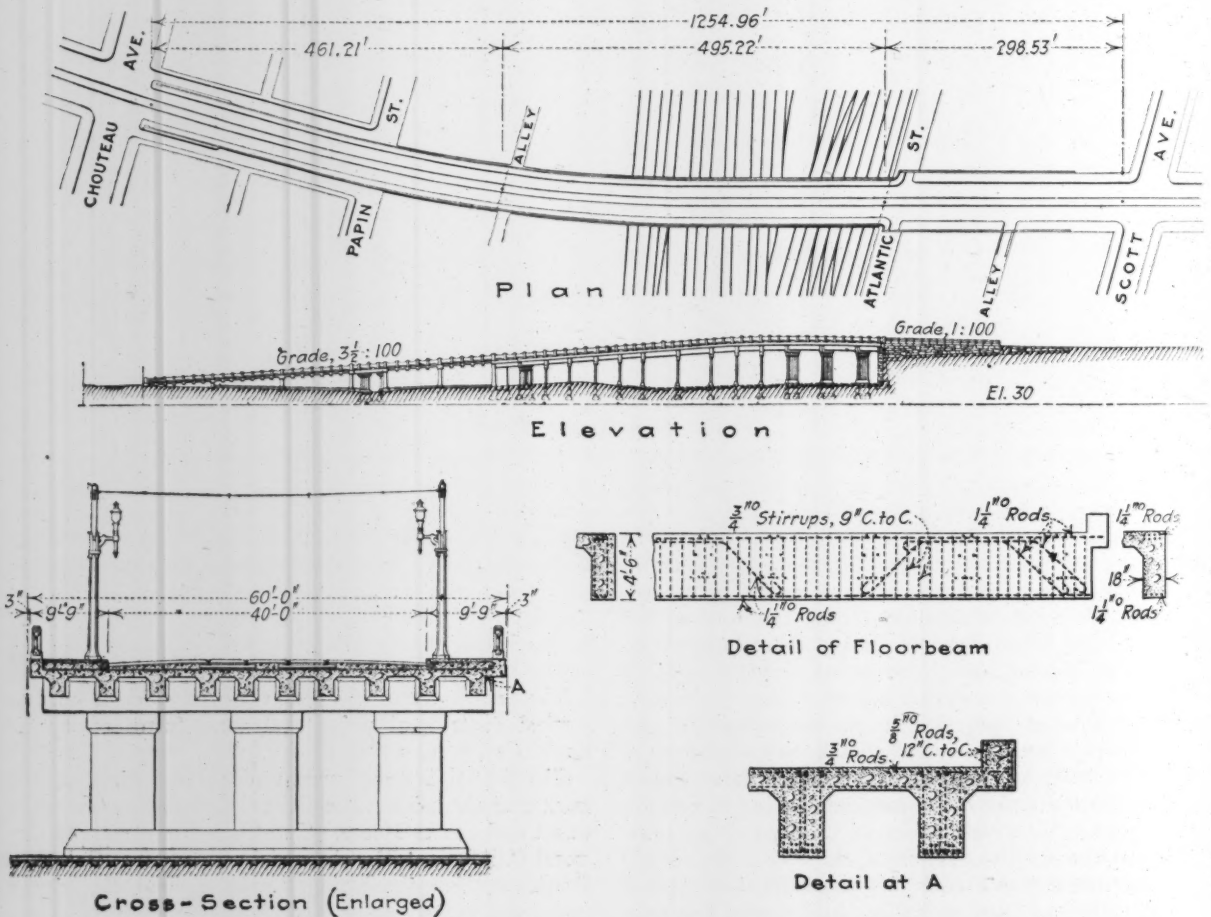


FIG. 1. DETAILS OF JEFFERSON AVE. VIADUCT AT ST. LOUIS, MO.

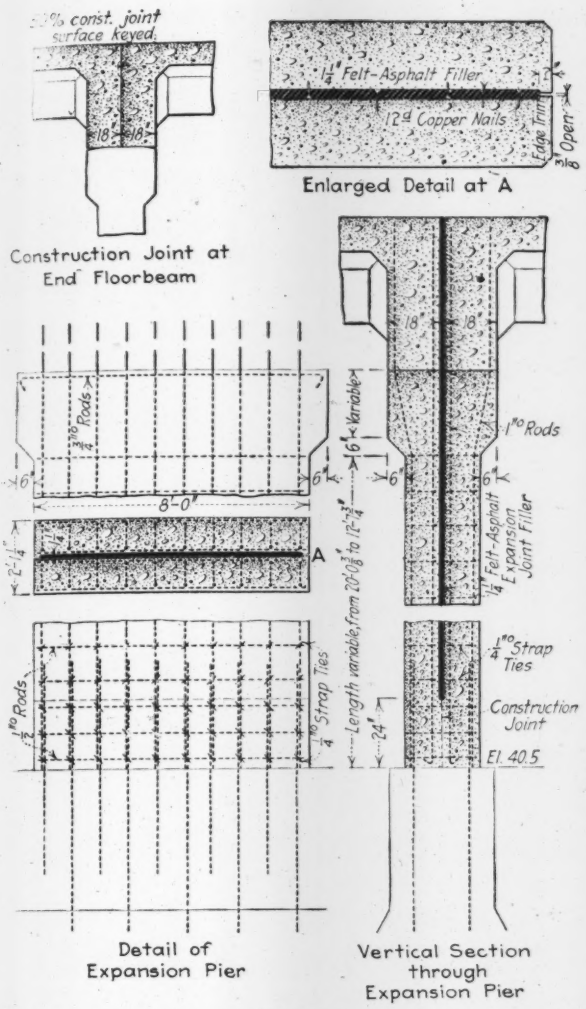


FIG. 3. DETAILS OF AN EXPANSION PIER, JEFFERSON AVE. VIADUCT.

The top surfaces of the deck slabs are flat and 12 in. below the street grade. At each side the slabs are flanked with copings that extend 15 in. above the slab to the sidewalk grade and carry the bridge railing. Over the slabs the roadway, walk, curb and car-track construction are laid as on a street. This arrangement augments the dead-load and consequently increases the cost, but it offers numerous construction advantages and provides space for conduits, pipes, etc.

Provision for Expansion

The bridge structure over the tracks is 495 ft. long. With the usually assumed temperature range and expansion coefficient, a distortion (expansion or contraction) of 1¼ in. might be computed for a concrete piece of that length. Frequently, movable bearings of iron or steel at intervals of from 100 to 200 ft. are used to provide for such distortions in long concrete bridges. In this structure a type of expansion joint is employed that obviates the necessity for such bearings. It consists of an arrangement of split pier shafts that, by flexure, make adjustment for the temperature distortions.

At four pier lines in the bridge structure the three vertical shafts of each pier are constructed as two independent halves, of 1x8-ft. horizontal section, with an elastic membrane 1¼ in. thick interposed. The end beams of the deck-span units abutting at these piers are also separated from each other, from out to out, by a like membrane and are each supported independently by a set of three of the half-sectioned shafts. The elastic membrane employed is a combination of felt and asphalt. The membrane is anchored to the concrete on each side of it with copper nails, and at the concrete faces the edges are finished with a trim showing only a ⅜-in. joint.

When the outside face or coping of a concrete-bridge span is cast integrally with the deck structure, settlements in the centering generally prohibit the attainment of good lines and grades. For that reason the copings in the Jefferson Ave. bridge were cast as a mask along the outside edges of the slabs after the deck structure was completed. The projection of the coping below the slab was an important feature in the attainment of good facial lines. It will be observed from Fig. 2 that the panels of the railing do not necessarily coincide with the bridge spans; that is, the railing posts are not just above the piers.

The railing posts and also the facia coping of the bridge structure are paneled with red terra-cotta tile inlays. These tiles were fastened in the forms with copper wire and the concrete cast around them. In order to prevent the discoloration of the tile face by the absorption of the watery grout which percolated between the tiles and the form boards the face of the tile was waterproofed with a solution of paraffin and naphtha.

A system of concrete poles at intervals of approximately 100 ft. along each curb line carries the bridge lights and the overhead wiring of the street railway. Each pole is reinforced with four full length 1¼-in. diameter bars and No. 10 wire hooping at 3-in. pitch. For the poles on the bridge deck the 1¼-in. bars were upset and threaded and extended 2 ft. beyond the butt end. As the poles were erected, these bars were dropped through pipes in the deck-slab concrete and anchored below with washers and nuts. End tenons 15x15 in. in section and 4 ft. 6 in. long were cast as an integral part of the poles, which were set on the earth embankments of the approaches. In erecting these the tenoned ends were dropped into mortised concrete foundations and grouted in place. The top cap, to which the trolley wires are tied, and the light brackets are of bronze. The light wires are carried

FIG. 4. VIEW ALONG JEFFERSON AVE. VIADUCT, SHOWING SPECIAL RAILING AND LIGHT POSTS

through the poles in 2-in. diameter "sherardized" pipe and along the bridge in 3½-in. diameter fiber conduits under the walks (Fig. 4).

The concrete in the railings and poles was made with gray granite aggregate graded down from a ½-in. maximum size. The proportions of the mix were 1:3 for the railings and 1:2½ for the poles, and 1% by weight of Medusa waterproofing compound was added to the cement for both. The surfaces were given a scrubbed finish, which slightly exposed the granite aggregate.

Heman Construction Co. was the contractor for the removal of the old bridge and the construction of the principal structural elements of the new one. All concrete, save that for the Papin St. span and the walls along the approaches, was handled from a mixer situated just south of the railway tracks. The sand and gravel were handled direct from cars to bins, situated over the mixer, by a derrick and clamshell bucket. The concrete was discharged into bottom-dump buckets mounted on trucks, pushed out by hand and picked up and carried by a 600-ft. span Lambert cableway to movable receiving hoppers. From these hoppers the concrete was distributed by chutes.

The cost of the viaduct complete was approximately $94,000. E. R. Kinsey is President of the Board of Public Service. L. R. Bowen is Bridge Engineer. The writer designed the structure.

Tests of Backing for Flexible Concrete River Mattress

By B. Okazaki*

SYNOPSIS—Method of river protection by means of small concrete blocks knitted into mattress by steel wire, described by Mr. Okazaki in "Engineering News," May 16, 1912, p. 922, Mar. 13, 1913, p. 512, June 25, 1914, p. 1405. This article recounts tests on various methods of backing so as to prevent percolation of water and consequent leakage of soil from under the mattress.

The flexible concrete mattress for river bank protection as placed in the Ishikari River district of Japan has two variations: Where the mattress is set in shallow water it is usually placed at once for its full width; where it is set in deep water it is placed in minimum width and is afterward supplemented by additional width when the scouring of the river bed in front of the mattress goes on. This addition of width is continued until the stream-side edge of the mattress reaches its destination, the bottom of the thalweg.

There is no reason to worry about any leakage of the soil through the interstices of the mattress when the scouring of the river bed in front is going on and the mattress is sinking down to follow the scoured new river bed. However, this leakage of soil is not welcome after the stream-side edge of the mattress has reached the bottom of the thalweg, as in the second case, or when the mattress is at first laid in full width, as in the first case, because then the stability of the mattressed bank is desired.

Soil such as gravel or tough clay does not scour or leak through the interstices of the mattress under ordinary circumstances, although there is a ¾-in. joint between adjacent vertical ends of blocks, but sand, lacking any coherence, is liable to leak through the mattress unless some proper lining, such as a fascine mat, is provided beneath the mattress. Such a lining as is shown in Fig. 1 has often been used, particularly when the sand is fine-grained.

In order to arrive at some basis for the design of such a lining or backing, the author made experiments on several kinds of lining that can be made of materials at his disposal and at a moderate cost. He assumed that on the bank with a given slope, the amount of leakage is in a certain way proportional to the velocity of river current just in front of the mattress and inversely proportional to the thickness of the permeable materials that compose the lining. To test the soundness of these assumptions, he made the experiments in four ways, as follows: (1) On a bare flexible concrete mattress with no lining; (2) on the same mattress with a layer of gravel 0.3 ft. thick and of grains from 0.08 ft. to 0.02 ft. diameter; (3) with a layer of wire knit fascine mat 0.35 ft. thick and (4) with double layers of the same fascine mat 0.35 ft. thick.

For the tests an experimental channel, shown in Figs. 2 and 3, was built. This channel consists of wooden-plank open conduits 60 ft. long, 6 ft. wide and 6 ft. deep, provided in the tailrace with a silt basin and an overflow weir the crest of which can be adjusted to any required height. An underground stave pipe 2 ft. square and 96 ft. long leads from a barge canal to an upper basin of the experimental channel, there being a regulating gate at the entry end of the stave pipe. On one side of the experimental channel is formed an artificial sand bank with an intended slope on which the mattress and the lining are laid.

The flow is adjusted by means of the entrance regulating gate and the height of the crest of the weir. The velocity of flow in the experimental channel is regulated by changing the discharge and by changing the width of the slit or pass formed between the experimental mattress

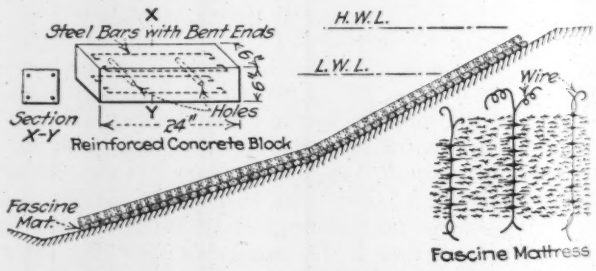
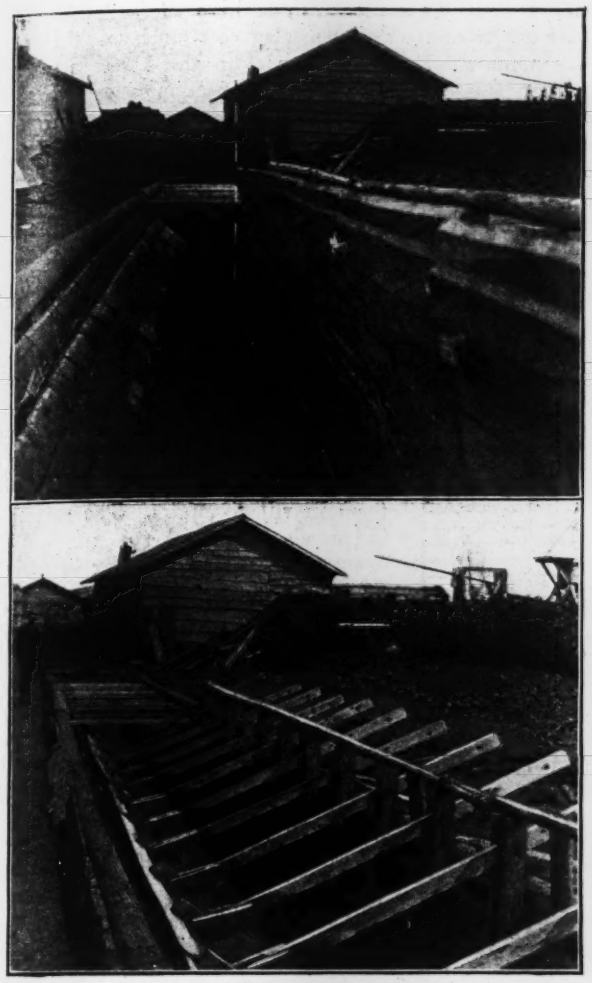


FIG. 1. FLEXIBLE CONCRETE RIVER-PROTECTION MATTRESS WITH FASCINE MAT BACKING

*Chief Engineer, Ishikari River Improvement Works, Sapporo, Japan.



FIGS. 2 AND 3. EXPERIMENTAL FRAME TO TEST RESISTANCE TO SILTING

Fig. 2 (Upper)—With lid turned up and mattress exposed
Fig. 3 (Lower)—With lid turned down against mattress

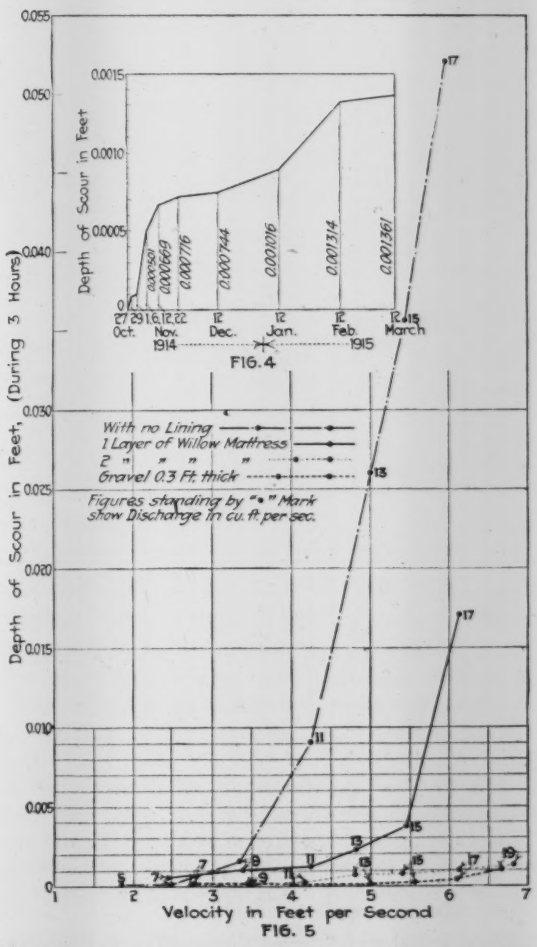
set on a sand slope of a given grade and a movable longitudinal lid or gate hinged to the foot of a side wall of the channel. Thus a given discharge divided by the corresponding cross-sectional area of the slit gives the average velocity of the current. The lid is kept at any desired inclination parallel to that of the opposite sand slope on which the mattress and the lining are laid, by simply turning it around the hinge by means of handles. In the experiments the velocity of flow was made to vary from 1 ft. per sec. to 7 ft. per sec. and the slope of 1.15 horizontal to 1 vertical was adopted.

The sand leaking through the mattress is deposited in the silt basin, allowing only water to overflow the weir. The sand deposited during one stage of experiment (usually 3 hr.) is collected from the bottom of the silt basin after emptying the water in the channel and the silt basin, and its volume is measured. The total volume of the sand divided by the total area subject to the scouring action gives the average depth of scour, and this depth converted into equivalent for 3 hr. is plotted as ordinate and the corresponding velocity as abscissa, as in Fig. 5. The long-time experiment with a lining made of a single layer of fascine mat 0.35 ft. thick was continued for several months for a velocity of 4 ft. (see Fig. 4).

The sand forming the slope in the experiment is taken from the river bank in the vicinity of the site of the Ishikari River improvement works at Bannaguro and its specific weight is 2.65, its grains varying from 0.005 ft. to 0.001 ft. in diameter. The gravel, which is rather small-grained, varying from 0.08 ft. to 0.02 ft. in diameter, is used to make 0.3 ft. thick lining.

Willow sticks not greater than 0.1 ft. in diameter are used for mat making, the mat being knit with No. 15 galvanized wire at 1½-ft. intervals, as shown in Fig. 1, the thickness of a layer of mat being 0.35 ft.

We may conclude from the results of the experiments that: (1) With no lining there is remarkable leakage beyond the velocity of 3½ ft. per sec.; (2) with a single layer of the fascine mat 0.35 ft. thick, there is a remarkable leakage beyond the velocity of 5½ ft.; (3) with double layers of the fascine mat there is no appreciable leakage even for a velocity of 6½ ft.; (4) with gravel lining 0.3 ft. thick there is the least leakage; (5) with a single layer of the fascine mat the long-time experiment shows that with a velocity of 4 ft. there is no uniformity in the rate of leakage and the depth of scour does not amount to 0.0015 during 135 days; (6) sand-tight lining can be made with either double layers of fascine mats 0.35 ft. thick or a 0.3 ft. layer of gravel whose grains vary from 0.08 ft. to 0.02 ft. in diameter when the velocity of current does not exceed 6 ft.



FIGS. 4 AND 5. DIAGRAMS SHOWING SCOUR FOR DIFFERENT VELOCITIES AND DIFFERENT KIND OF BACKING

Public-Works Accounting for Villages and Towns

By Charles A. Holden*

The efficient management of municipal affairs requires carefully kept records, the minuteness of detail depending upon the outlay which the amount yearly expended will justify. This is a matter of importance for villages as well as cities, but perhaps more often overlooked by the smaller places than the larger.

COMMISSIONERS OF THE VILLAGE PRECINCT OF HANOVER, N. H. ORDER NO. 499

AUDITED ..... AMOUNT $ .....

APPROVED BY ..... PAYEE .....

DATE 191

DISTRIBUTION OF EXPENDITURES

MAINTENANCE				CONSTRUCTION AND IMPROVEMENTS				
ACCT NO	ACCOUNT CHARGED	AMOUNT	KIND OF WORK	ACCT NO	ACCOUNT CHARGED	AMOUNT	KIND OF WORK	REMARKS
	STREET DEPARTMENT			57	STREET DEPT. Pipe Drains & Manholes — Trunk Line / State Aid / Other			
	..... St.							
1	Cleaning & Repairs — Trunk Line / State Aid / Other			58	Road Foundation and Surface — Trunk Line / State Aid / Other			
2	Sweeping			59	Cross Walks			
3	Sprinkling			60	Equipment (Mchy. & Tools)			
4	Oiling			61				
5	Removing Snow			62				
6	Snowing Bridge			63				
7	Rolling Snow and Breaking Roads				FIRE DEPT.			
8	Sanding Walks			64	Equipment			
9	Repairs to Equipment				POLICE DEPT.			
10	Replacement of "			65				
11	Stone Crusher—Operation				PRECINCT HALL PROPERTY			
12	" " Repairs and Replacements			66				
13	Materials & Supplies—Stock			67				
14	Trees and Shrubbery				Other Construction			
15				68				
16	Work or Supplies Outside Parties				WATER DEPT.			
17	Miscellaneous				HEALTH DEPT.			
	STREET LIGHTING				Total			
	FIRE DEPT				SUMMARY OF DISTRIBUTIONS			
	POLICE DEPT				Maintenance			
	WATER DEPT				Construction & Improvement			
	HEALTH DEPT				Previously Distributed			
	PRECINCT HALL PROPERTY				Total			
	DEBT—Principal							
	" —Interest							
	GENERAL							
	TOTAL							

*F—Freight R—Repairs
L—Labor S—Services
M—Materials T—Teams

STATEMENT

DATE WEEK ENDING | AMOUNT

Account to 191 To date being

TOTAL

COUNTERSIGNED:

COMMISSIONER

COMMISSIONER

COMMISSIONERS OF THE VILLAGE PRECINCT OF HANOVER, N. H

ORDER No. 499

HANOVER, N. H. 191

DARTMOUTH NATIONAL BANK 94-116

OF HANOVER, NEW HAMPSHIRE

PAY TO THE ORDER OF ..... $ .....

..... DOLLARS

100

IN PAYMENT OF BILLS AS PER STATEMENT ANNEXED.

TREASURER

FIG. 1. VOUCHER CHECK, WITH DISTRIBUTION STUB, HANOVER, N. H.
Original, 8⅜x11 in., on blue paper

Unless one has studied the subject with care, he does not realize the expenditure for record keeping which will be repaid by the resulting efficient management and the prevention of leaks. Just as soon as one begins seriously to keep records he begins to study more carefully the costs and to plan operations far in advance, that they may be done economically and harmoniously. He studies the seasonal effects on the cost of construction and many other phases of the subject to which he had previously given no consideration. For example, he notices that trenches for drain pipes can be laid before the [in]tense heat of the summer with a labor cost much less [than] in the summer. He buys material in the lowest [mar]ket, takes advantage of cash discount, uses more care [to] see that materials and tools are kept in a central and [pro]per location instead of lying scattered around where they deteriorate rapidly and are perhaps lost altogether. He realizes that it is not economy to expend labor for borrowing a tool and making repairs on it equal to perhaps three-quarters of what the tool would cost new, with the result that when the work is done there is no equipment to show for the expenditure, whereas if the tool had been bought new, seven-eighths of the value of the expenditure would have been added to assets. Neatness, orderliness, thrift and improvement spread contagiously in any locality where the village authorities practice them in village affairs. The reverse is true also.

One does not go very far in such records without a keen appreciation of the value of, and necessity for, a good superintendent who will see that full value for money paid will be rendered by teams and labor and that it is wasteful to turn the work over to a man with no peculiar training for the work, especially if he is to be in charge for only a year or two and is then to be succeeded by a new man who must begin the same or similar experiments with the same or worse failures and dissipation of energy. It is with the hope of assisting in stimulating and extending more efficient management in the affairs of towns that attention is directed to these matters and that a list of the minimum accounts and forms necessary is given herewith:

1. Weekly timebook.

2. Daily distribution of labor to the different kinds of work. (Carbons to be kept of this so that the superintendent in charge of the work and the board of government of the town may each have a statement to date of the work being performed. Also if the book is lost, there is a set of records in reserve.)

3. A weekly summary of the daily distribution.

4. A weekly payroll.

5. Teaming slips giving distribution of the work of the teams for the day, which each driver hands to the superintendent each day (Fig. 2).

6. Stock-record slip to give movement of any stock during the day. Since the stock distribution is one of the hardest to keep straight and since it is of the utmost importance in accounting for the expenditure of the public money, this record needs to be kept with great care (Fig. 3).

7. Stockbook, to which items from 6 are transferred.

8. Order-book carried by the superintendent, who for each purchase gives a written order with a carbon copy which he keeps.

9. Voucher checks with distribution items, the same as on the weekly summary and in the account-book (Fig. 1).

10. Account-book, in which are recorded the data from the voucher checks.

11. Notebook (for borrowing money) with numbered pages and record stub so that the authorities will have to account to the auditor for all missing pages in the notebook.

*Chairman, Hanover Precinct Commissioners; Professor of Civil Engineering, Thayer School of Civil Engineering, Dartmouth College, Hanover, N. H.

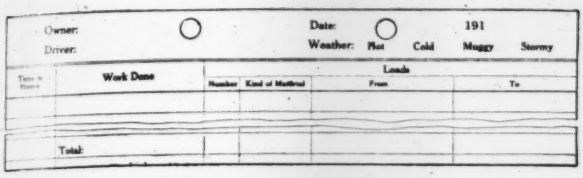


FIG. 2. TEAMING SLIP, HANOVER, N. H.

Original, 8⅜x4⅞ in., on white paper, with 12 lines for entries, including total

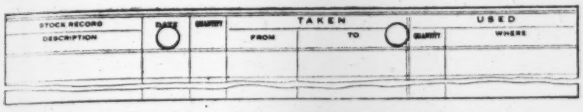


FIG. 3. STOCK RECORD SLIP, HANOVER, N. H.

Original, 7⅛x3⅜ in., on pink paper, with eight entry lines

12. Expenditure record, giving opposite each month the expenditure each year, so that the amount expended in any month of any year or from the first of each month for the remainder of the year will be available in tabular form.

13. Order-book for materials, issued in triplicate.

14. Billing-book for work performed or materials sold, issued in triplicate. (In all cases when duplicates or triplicates are kept, the originals and copies should contain the same printed number.)

With such a system of records and a good superintendent in charge, it will be possible to secure the services of better men as selectmen or commissioners. These men would otherwise be unable to give the time necessary to attain results without which they would not undertake the work.

It is only through keeping adequate records that a proper report can be made to the taxpayers. This report should show at a glance on adjacent facing pages a summary of receipts, disbursements, assets and liabilities in comparison with those of previous years. Between the general statements should be enough detailed accounts arranged in a form to make possible an intelligent study of the affairs of the town by interested parties. At the end of the report should be a budget of estimated expenditures for the next year.

Finally, some standard system of accounting and of superintendence should be adopted so that, as selectmen come and go, the affairs of the municipality shall be kept in the best condition possible.

Measuring Locomotive Coal

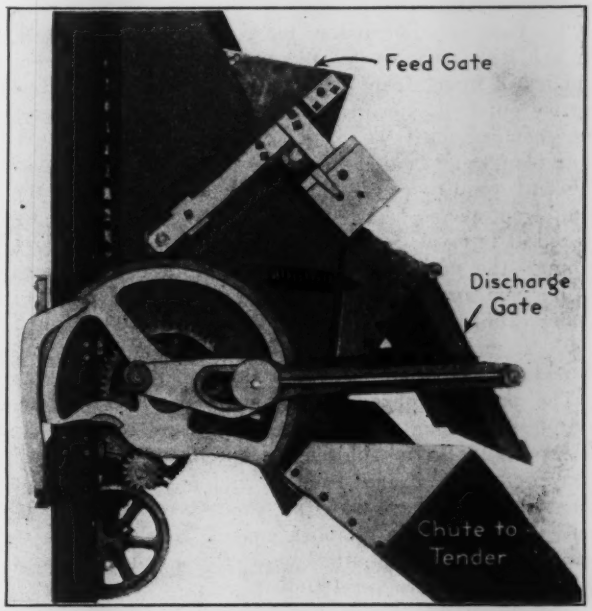
The loading device shown in the accompanying view is for railway coaling stations and is intended to avoid the usual difficulties in the way of keeping close record of the amounts of coal delivered to the various locomotives. It consists essentially of a measuring hopper of one-ton capacity, having a feed gate at one end to admit coal from the elevated storage pocket or bin and at the other end a discharge gate through which the coal is directed into the inclined chute that delivers it to the tender. The two gates are so connected by mechanism that they work in sequence.

The mechanism is operated by a ¾-hp. electric motor, or by means of a hand chain at stations where current is not available. The main shaft makes four revolutions per minute, and with each revolution the measured quantity of 40 cu.ft. of coal (equivalent to one ton) is delivered to the tender.

The locomotive is spotted with its tender under the hinged chute, which the fireman (standing on a platform) lowers by a chain. He then throws the handle of the controller to start the motor. The feed gate, being opened, admits a charge of coal to the measuring hopper and then closes. As soon as it is closed, the discharge gate is opened, allowing the coal to flow to the chute and tender.

As soon as the discharge gate is closed, the feed gate again opens and the operation is repeated, delivering a measured ton of coal every 15 sec. When a sufficient supply has been taken, the fireman throws the controller handle to stop the loader and then raises the chute. This chute has a hooded end, so that the coal drops vertically at the center of the tender.

Record of the amount taken by each engine is effected by means of a counter placed on the coal bin, with figures easily readable from the engine. The fireman marks on his coal ticket the number of his engine (say 152) and the date. When the engine is spotted at the coaling station, he marks the number shown by the indicator on the loading device (say 250). After the tender has been filled, he again notes the number shown (say 257). Thus it is evident that engine No. 152 has taken seven tons of coal. As the first number on each ticket must correspond with the last number on the previous ticket, any attempt to show a lower amount of coal than actually taken would be readily apparent.



MEASURING LOADER FOR RAILWAY COALING STATIONS

Made by the Roberts & Schaefer Co., Chicago

At the coaling station of the Nashville, Chattanooga & St. Louis Ry. new terminals at Cowan, Tenn., all coal is delivered and recorded by four of these loading devices, and during the period Apr. 17 to May 15, 1916, there were 4,623 tons delivered. A test made with one of the loaders showed that 15 tons recorded actually weighed 30,270 lb. on the scales; this is an overweight of only 18 lb. per ton.

This device has been applied at a number of coaling stations. It is known as the Rands measuring coal loader and is built by the Roberts & Schaefer Co., of Chicago.

Strength of Burnettized Timber To Be Studied

By J. M. Barker*

An investigation is being carried out at the Massachusetts Institute of Technology to determine the effect of the Burnett, or zinc-chloride, process of wood preserving on the strength of structural timber. A few results are already available.

It has been suspected for some time that the strength of Burnettized timber is dependent on a number of conditions, chief of which are the strength of the salt solution used, the temperature and humidity of the air in which the timber is placed and the age of the treated piece. It is important also to know the nature of the physical and chemical changes that go on in the cells of the impregnated wood. This investigation has been planned to throw light on these phases of the problem of wood preservation.

Test Specimens and Procedure

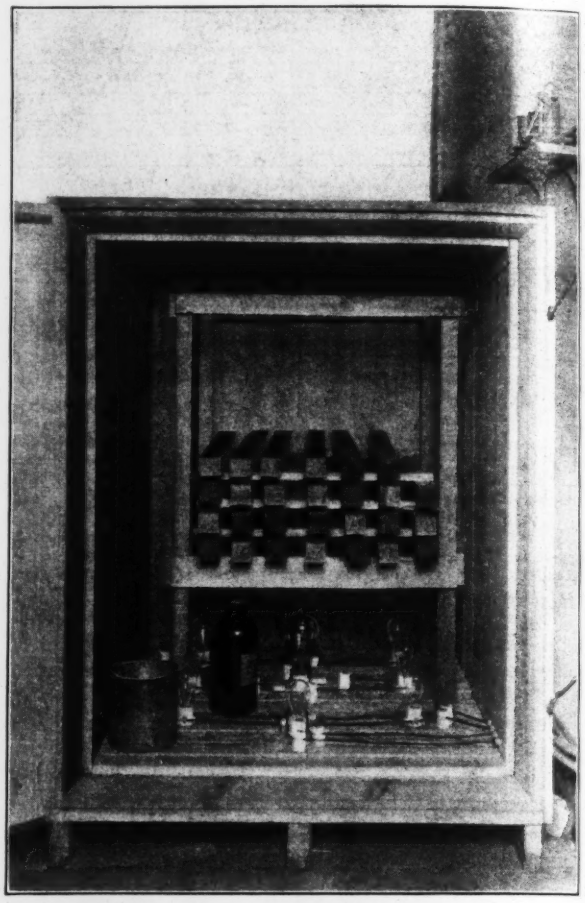
The specimens used are selected pieces of North Carolina loblolly pine sapwood, 2x2x30 in. Loblolly sapwood was chosen on account of its susceptibility to the attacks of fungi and its absorptive power. In order to have a basis for comparison, for every stick treated with zinc chloride an untreated piece is set aside to be stored and tested under identical conditions. Impregnation is carried out by immersing the sticks in a cold solution of the chemical until ½ lb. per cu.ft. has been absorbed. Both blanks and treated pieces are stored under a range of constant conditions of temperature and humidity, the number of pieces being such that specimens can be removed at intervals for testing. They are stored in three groups—the first in a room under ordinary conditions of temperature and humidity, the second and third in heater cabinets at constant temperatures of 100° F. and 150° F. respectively. The series of tests is planned to extend over a period of at least three years.

The proposed physical tests are transverse bending, compression along the grain and moisture content. It is proposed also to subject the specimens to chemical and microscopic examination to find out the nature of the changes that have taken place in the cells of the timber. It is hoped to establish general conclusions as to the advantages and limitations of this method of wood preservation in structural timber.

This work was begun in 1915 by A. H. Clarke, a student in the senior class, who studied the general plan of the investigation and devised the apparatus used. In order to try out the method proposed, a preliminary short-time test was run during the spring of 1915, with results that seem sufficiently interesting to warrant brief mention here.

Bending Strength Reduced 17% by Treatment

Ten sticks 2x2x30 in. were cut from the same timber, and five of these were treated. The ten sticks were stored in a cabinet for about forty days at a constant temperature of 150° F. A large pan of water was kept in the cabinet, which gave a humidity of about 13%. The surface of the treated sticks changed gradually to a dull, dark-brown color, which extended into the wood from $\frac{1}{32}$ to $\frac{1}{16}$ in. The ten sticks were tested in cross-bending,



HEATED CABINET FOR STORING SPECIMENS AT TEMPERATURE OF 150° F.

with the result that the modulus of rupture of the treated specimens was less in every case than that of the blanks, the average being 17% less. The moisture content of these specimens was about 2%.

In considering the results of tests on such specimens as these, it must be kept in mind that they are of small size and have much more surface per unit volume than do large pieces. For example, a 12x12 in. by 15 ft. stick has only one-sixth as much area per cubic unit as the test specimen. It seems probable that the weakening takes place near the surface for the most part, and therefore it might be expected that the effect on large pieces is not as severe proportionally as on these small ones. It is hoped to gain more complete data regarding this point by tests on large specimens.

Saturated Solution Destroys the Wood

An idea of the powerful destructive effect of zinc chloride in concentrated solutions may be had from the results of an experiment with miniature specimens. Several pieces of the same timber cut into sticks ¼x½x7½ in. were placed upright with their ends in a saturated solution of the chemical and left in the cabinet at 150° F. for seven days. At the end of that time they looked like pieces of charcoal and had no more strength than that substance.

The tests so far are, of course, a sign post and not a map. They point out that there is a reduction of strength due to the zinc-chloride preservative treatment

*Massachusetts Institute of Technology, Boston, Mass.

when timber so treated is subjected to moderately high temperatures. How much this reduction must be reckoned with in pieces of commercial sizes and how such factors as strength of solution, temperature, humidity and age affect it should become much clearer as the experiments progress.

The need for research of this character was suggested by F. J. Hoxie, Special Inspector for the Associated Factory Mutual Fire Insurance Companies and Special Lecturer at the Massachusetts Institute of Technology, and his advice has been very helpful.

Water-Filled Ashpit on the Baltimore & Ohio R.R.

The terminal improvements of the Baltimore & Ohio R.R. at Chicago include a water-filled double-track ashpit to receive the ashes discharged from the locomotives when cleaning the fires. This is shown in Figs. 1 and 2.

The pit is of reinforced concrete. It is 150 ft. long, 28½ ft. wide over all, with sloping sides and a flat floor 14 ft. wide. Cross-walls on each side, extending as far as the floor, carry a girder consisting of a pair of 20-in. I-beams incased in concrete. The upper part of each side wall is of brick, and the girders rest on brick pedestals on the cross-walls. The brickwork is laid in cement mortar, with alternate headers and stretchers in all courses. The pit is 13 ft. 3½ in. deep.

The two tracks are over the sloping sides of the pit, each track having one rail carried on the side wall and the other on the girder. The rails are 100-lb. per yd., secured by clamps and nuts on anchor bolts.

The 14-ft. central portion of the pit is obstructed only by two cross-girders, which are in line with the first cross-walls at each end and serve to support planks. Thus the ashes can be removed readily by a grab bucket handled by a locomotive crane. These cross-girders are 15-in. channels incased in concrete. The bottom of the pit has

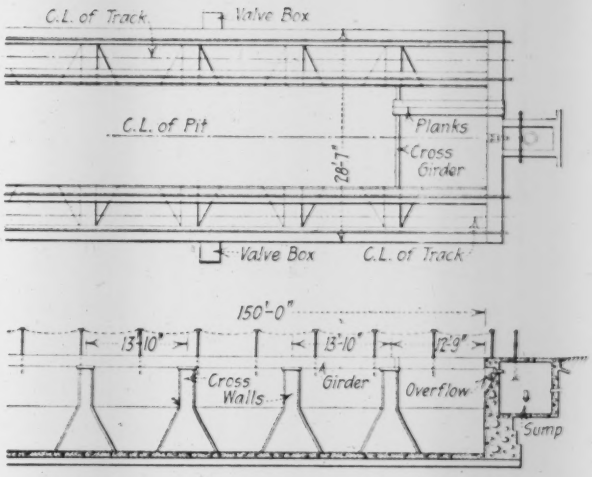


FIG. 2. WATER-FILLED ASHPIT AT CHICAGO

lines of old rails embedded in it to protect the concrete from damage by the grab buckets, and for the same reason the corners of the cross-walls are faced with angles.

Water is supplied by hose from four valve boxes along the sides of the pit. The overflow pipe is about 11 ft. above the bottom. This pipe is placed in one of the end walls and leads into a sump. The ashpit was designed under the direction of F. L. Stuart, Chief Engineer, Baltimore & Ohio R.R. It was installed under the supervision of L. G. Curtis, District Engineer at Chicago.

Water-filled ashpits of the same general type have been built by other railways. The Committee on Buildings of the American Railway Engineering Association, in its report of 1916, shows a pit similar to that of the Baltimore & Ohio R.R., except that the central portion is wide enough (approximately 30 ft.) for a central track carried by girders on a row of piers. This track is for the ash cars, which are loaded by means of a grab bucket handled by an electric gantry crane which spans the three tracks.

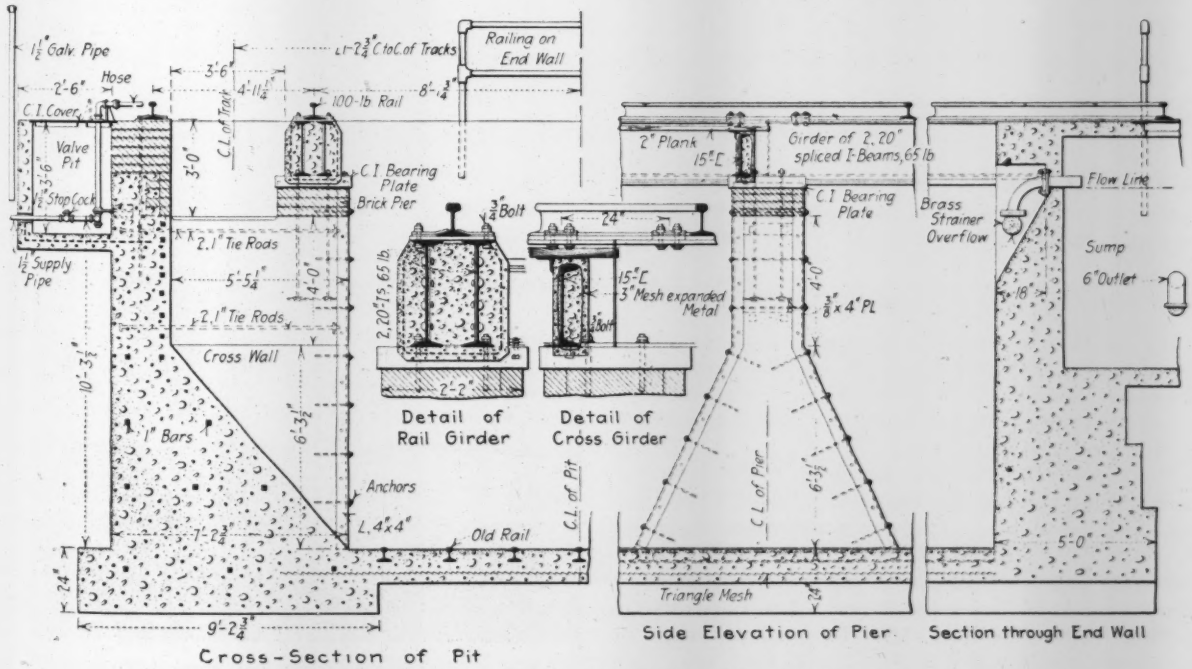


FIG. 1. DETAILS OF CONSTRUCTION OF WATER-FILLED ASHPIT; BALTIMORE & OHIO R.R.

New Trench-Excavation System

SYNOPSIS—Difficult Brooklyn excavation is being handled with horizontal sheeting at large saving. This is made practicable for large excavations by use of narrow trenches for setting the sheeting, and subsequent placing of permanent bracing while core is removed; patented by John F. O'Rourke.

Two difficult pieces of deep trenching are going on in Brooklyn, New York, at the present time with the use of a new system of trenching, or rather a new method of opening sheeted excavations of large size. Horizontal sheeting is used, to eliminate both the disturbance of ground due to driving sheetpiles and the large increase in volume of excavation which is entailed by the stepping out of successive tiers of sheetpiles in deep work. The method is suited to dry ground only.

There are two essential parts to the system; first, the kind of sheeting used, and, second, the procedure of excavating, in which the sheeting is set in narrow trenches dug along the outside of the excavation, and bracing is placed later as the core is removed. The latter is covered by a patent recently granted to John F. O'Rourke, Chief Engineer of the Flinn-O'Rourke Co., on whose work are the two jobs where the method is now employed. Mr. O'Rourke says that the method saved one-third the total excavation on one job and is going to save about one-fourth on the second job; the money saving on the two jobs put together is figured at about $100,000.

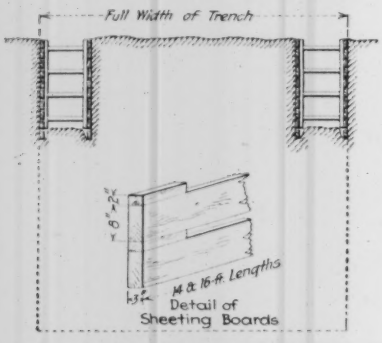


FIG. 1. SKETCH OF SHEETING AND NARROW TRENCH METHOD

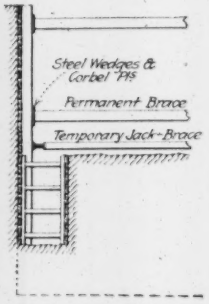


FIG. 2. REMOVING CORE AS TRENCHES GO DOWN

Kind of Sheeting; Spaces for Packing

The sheeting is placed so that spaces are left between the successive sheeting boards, 2 in. wide in vertical direction. Blocks of 2-in. thickness nailed on one edge of each sheeting board, near each end and at intermediate points, form this space.

This form of sheeting was developed in the course of underpinning work at the St. George Hotel, Clark and Hicks St., Brooklyn. The pits sunk under the piers of this tall and heavy building to depths of 75 ft. and over were sheeted horizontally, using at first sheeting of the Breuchaud louver-board type. Later square-edge openings were substituted for the inclined slots in accordance with the sketch, Fig. 1, and the results were found at least as good as with the inclined slot while the preparation of the board was much simpler. The spaces between boards were used for packing earth back of the lowest or last-placed sheeting board, which packing held the ground from running down into the space scooped out for the next sheeting board below.

Excavation of Henry St. Shaft, Clark St. Tunnels

The trench and core method was developed from the favorable experience with horizontal sheeting in avoiding loss of ground. It is a means of applying horizontal sheeting to large and deep excavations in complete security by reducing the operations of placing sheeting to those of sinking a narrow trench, i.e., separating the tasks of sheeting and bracing. The method was first used at a large station-entrance shaft for the Clark St. tunnels, which is being constructed in the lot adjacent to the St. George Hotel and will later be covered by an addition to the hotel.

The shaft is 35x53 ft. and 83 ft. deep. The whole depth is in sand containing boulders and similar obstacles. To excavate the shaft by the use of driven sheeting (5 tiers) would have made the top about 15 ft. larger in each direction and thereby would have increased the total excavation of 5,200 cu.yd. by 2,550 cu.yd. of useless excavation; besides several nearby parts of the hotel buildings would have had to be taken down. All these difficulties were avoided by the use of horizontal sheeting.

Objection was made by the owners of the lot to any method of construction which would leave timber in the ground to decay and cause future settlement. The contractors satisfied this objection by placing grout and mortar packing behind the sheeting. The space for a

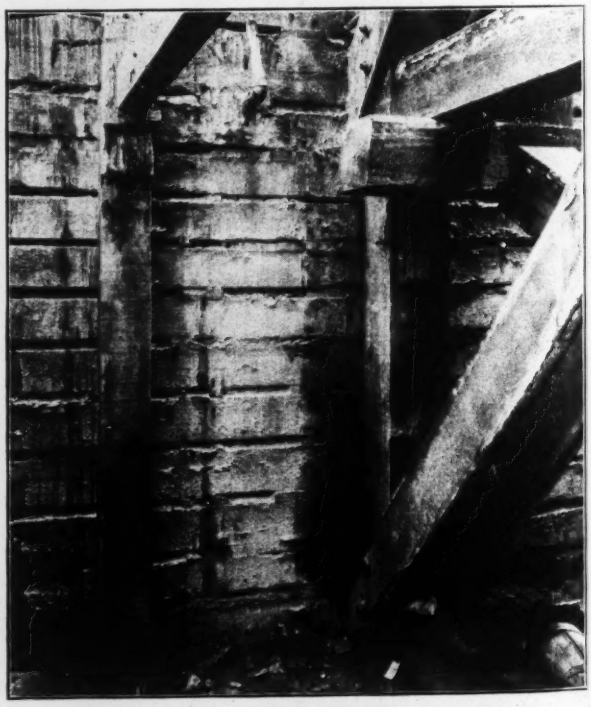


FIG. 3. CEMENT-BACKED SHEETING OF HENRY ST. SHAFT IN BROOKLYN

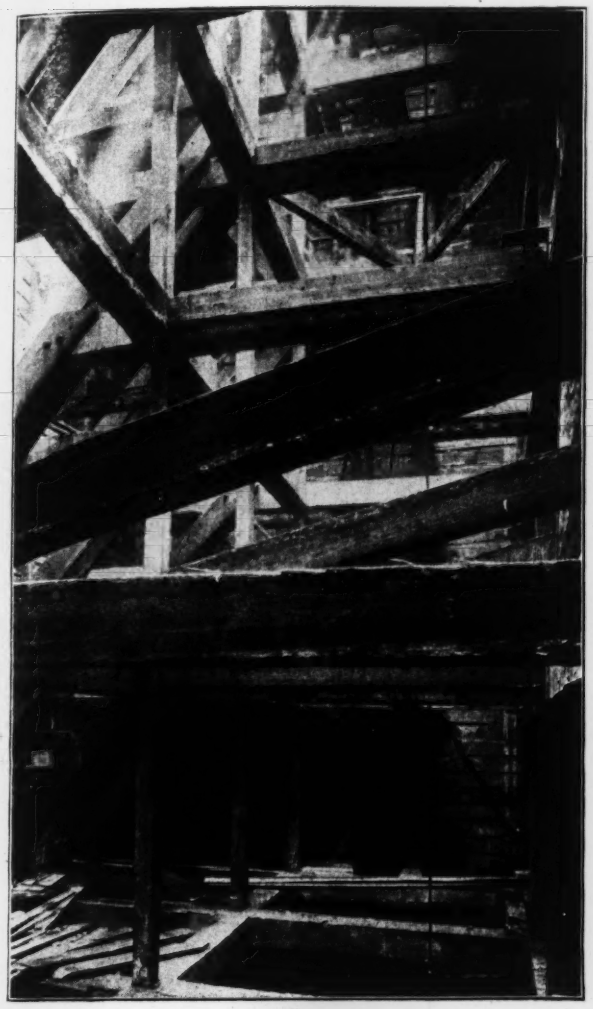


FIG. 4. VIEW UP HENRY ST. SHAFT
Sunk by narrow-trench method. All sheeting horizontal. Transverse braces through; longitudinal braces cut in

sheeting board was dug out 4 in. back of the outer line of the sheeting, so that when the board was placed, lined up plumb and held by bracing in front, there was a 4-in. space behind it. This space was at once filled by pouring in grout and finally keying up with stiffer mortar. By the time the board next below had to be placed, the grout and mortar were already set hard and formed a satisfactory dam to prevent material running down when clearing the space below.

The trench wall thus formed consists of the 3-in. sheeting and the 4-in. thickness of concrete outside, bonded into the spaces between the boards. As the permanent lining concrete of the shaft will be placed directly against the inside of the sheeting boards, the boards finally will be completely incased in concrete. After the decay of the boards there will be narrow spaces left in the concrete something like the openings in hollow tile. It is considered that this method of construction will obviate all settlement.

The shaft excavation was carried down entirely by the narrow-trench method, working around the four sides of the excavation simultaneously. Figs. 1 and 2 illustrate the essential steps. In Fig. 1 is a sketch showing the trenches sunk for placing the sheeting, and Fig. 2 shows the operation of taking out the core and putting in the bracing. The trenches were kept about 10 ft. below the bottom of the general excavation. Setting the main system of bracing for the shaft as a whole proceeded above while trench work was going on below. The sheeting boards of the inner faces of the trenches after they were removed were dropped to the bottom of the trenches and there used in carrying down the sheeting.

The section of the shaft (Fig. 6) shows the timbering as originally sketched out. As actually built, there are no horizontal rangers along the wall but the transverse braces butt directly against the vertical rangers. The transverse braces are continuous and the longitudinal braces are cut in between them. At the outer ends of all braces 14-in. square packing plates in pairs, with iron wedges between, are used to enable the braces to be tightened. There is also some diagonal bracing in the horizontal plane in the panel adjacent to the outside, to brace intermediate vertical rangers of the sheeting, and there is a small amount of vertical diagonal bracing and kneebracing not shown in the section.

60-Ft. Trench for Subway in Fulton St., Brooklyn

More extensive use is made of the method in the Fulton St. open-cut subway work. Here the method is applied in its normal manner, without mortar packing. The Old Slip-Clark St. tunnels pass into open-cut subway construction in Fulton St. at Pierpont and soon afterward cross over the South Ferry-Montague St. pair of

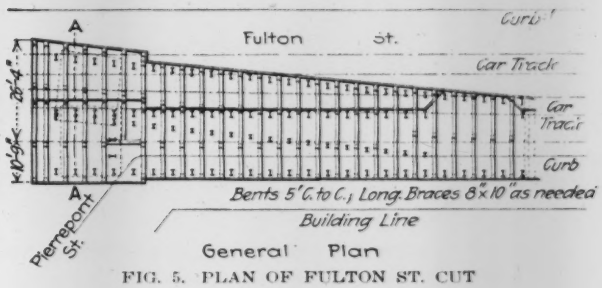


FIG. 5. PLAN OF FULTON ST. CUT

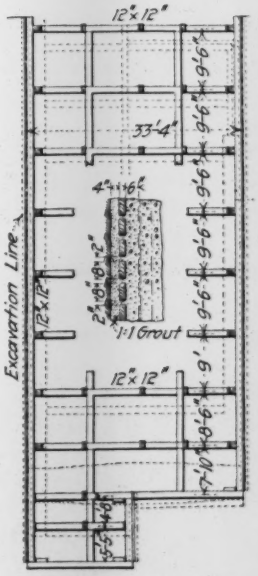


FIG. 6. SECTION OF HENRY ST. SHAFT

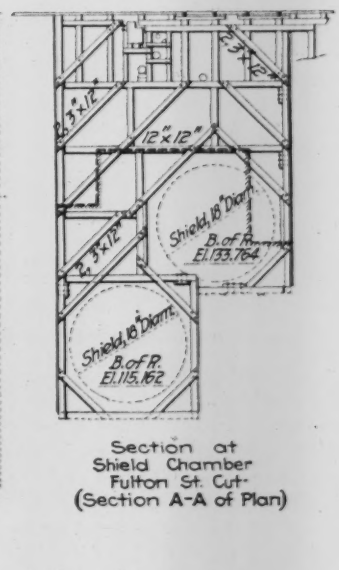


FIG. 7. SECTION OF FULTON ST. CUT

tunnels. In this region the street excavation is about 60 ft. deep. All of it is being taken out by the narrow-trench method. The side trenches as used here are about 5 ft. wide inside of rangers. The sheeting used is 3x6, with 2-in. blocks as described before. The excavation is in slightly coherent sand, and only in a few places is outside earth being brought in for packing behind the sheeting through the spaces between boards. The material is generally firm enough so that the bottom of the trench can be shoveled down to a foot or more below the lowest sheeting board and thus the operation of clearing ground for the next sheeting board and placing this board considerably simplified.

The temporary ranger system in the narrow trenches is put in piecemeal as temporary blocking, board by board, and after five or six boards are set the regular system of temporary rangers placed. The trench is

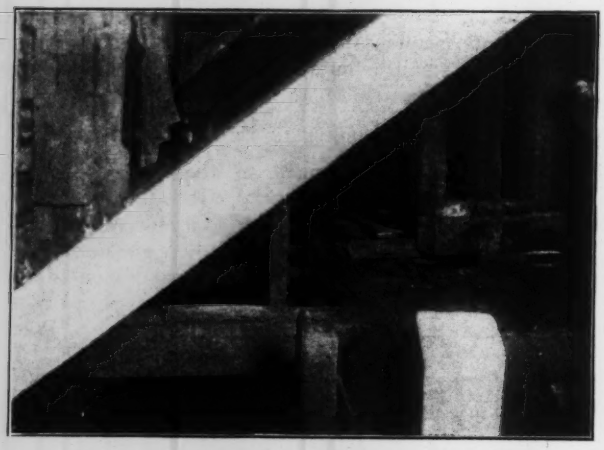


FIG. 8. NORTH WALL OF FULTON ST. CUT

Main excavation about 25 ft. below street planking. Sheeting trench 18 ft. lower, to go to 20-ft. depth along side shield-dismantling chamber. The heavy horizontal timbers are 12x12 transverse through braces at level of roof of shield chamber.

kept about 10 ft. below the general excavation level and this allows for extending the permanent 12x12 bracing rangers in full sections.

At the western end of the excavation, where a chamber for dismantling the shields of the tunnel is formed in the timbering, the arrangement of bracing is as shown in the lower part of the section. Here the side trenches have to be carried down the full 20-ft. height of the shield chamber, so that the permanent rangers in this height can be set in a single piece in order to form a rigid frame when the kneebracing is put in. The bracing of this section throughout is so arranged as to give rigidity and strength even in case of local settlements or failure of supports.

Figures on Saving of Excavation

The saving of 2,500 cu.yd. of excavation in the Henry St. shaft has already been mentioned. The Fulton St. cut contains a pay volume of 45,000 cu.yd. of excavation. With three tiers of vertical sheeting (20-ft. tiers) there would have been 14,000 cu.yd. additional to be excavated outside the pay line. All this additional excavation is saved by the horizontal-sheeting method. Mr. O'Rourke estimates that the saving to his company on the Henry St. shaft was at least $25,000, and that there is likely to be three times as great a saving in the Fulton St. cut.

The method was patented Apr. 18, 1916 [illegible] 1,179,750). The patent covers not only the application of the narrow trench method as here described, but also its use in cases of very wide excavations where it is not desired to extend the bracing across the excavation but instead to brace by rakers. It provides for placing the sheeting with only the complication incident to temporary bracing of the narrow trench and putting in permanent bracing afterward as a second and separate operation. A typical claim of the patent is as follows:

The method of producing an excavation consisting in making spaced trenches, bracing the outer walls of such trenches against the inner walls thereof, excavating material between said trenches for the desired excavation and bracing the outer walls of said excavation together.

The inventor has also just made an unusual offer to contractors, namely, to allow any contractor the free use of the method on half of any job he may be doing where it is suitable; if he then desires to use it for the other half of the job he may obtain a license therefor on paying one-quarter of the reasonable saving of cost secured by the method.

The Applicant's Difficulty

By R. Fleming*

It may be inferred that the writer of a letter making application for a position will express himself at his best. An analysis of 493 letters written during the years 1914 and 1915, applying for engineering positions, gives some interesting results. Of these letters 217 were from college men, either graduates or members of graduating classes. Fifty colleges were represented. Only about one letter in three from these college men could be called "good," and hardly one in twenty would receive special attention. In fact, the applications of two men stating "I am not a college man" and some letters from boys wanting to be tracers made a more favorable impression than those from the majority of college graduates.

What are some faults in their letters? In the first place, 95 out of the 217 were on notepaper. A favorite-sized page was 5x6 in. There is a semblance of authority for the use of notepaper in at least one handbook, but the advice of a professor to his senior class might well be followed:

When you write a letter applying for a position, use business paper and not love-letter stationery, for a business letter is not a love letter.

Notepaper is inconvenient for filing. What engineer has not had personal experience with applications "filed for future reference"?

Poor Handwriting and Spelling

Careless handwriting is another common fault. Fine penmanship is not vouchsafed to many, but the writing of everyone can be at least legible. A consulting engineer writes in such a slovenly manner that his letter is hard to read. He may have thought that his letterhead would do away with the necessity of writing distinctly. It is often difficult to read the name at the end of a letter. An associate professor of drawing wants a salary of $40 a week, but one can only guess his name. The same is true of a candidate "for a responsible position."

*American Bridge Co., 30 Church St., New York City.

A graduate of an institution like . . . should not be a "beginer," nor should a graduate of . . . be "thankfull." Perhaps the man who writes "weather," "material" and "having had ample technical education to warrant a drauftsman's position" is not a college graduate.

Many applications give too little definite information. Such statements as "I am a college man," "I am a graduate from an engineering school," "have a fine technical education, being a college graduate," "am technically educated," could be better expressed by giving the name of the college and the year of graduation.

Serious Faults of Style

A flippant tone in a letter is not conducive to its favorable reception. One man writes:

> However, it is not my intention in submitting same, that it be placed on file for some future manager to cast into the wicker morgue, because sir I graduate from the Civil Engineering Course of . . . the coming June, and the position for which I am making application can be filled at that time.

A bombastic or too confident tone is not to be commended. The man who writes:

> Have had 13 years' experience in structural drafting. . . . Have never made an expensive error in any work I have turned out. . . .

may never have had much responsibility thrown upon him.

The following letter is unclassified:

> I am a young man (19). I have received a 4 year Civil Engineering Education and a year of Field Experience I am fully versed in designing and constructing steel structures, Reinforced Concrete, also numerous other things in the Engineering line.

An irreverent hand had written in pencil, "Some boy!"

Sypherd, in his "Handbook of English for Engineers," summarizes weak points in letters of application under: Poor Beginning, Faulty Sentence Structure, Excessive Use of the First Person, Excessive Modesty and Miscellaneous Errors. He gives the advice:

> Begin at once without any preliminary explanation with a statement of what you desire; say briefly, straightforwardly and without assuming too great knowledge or skill, whatever you think your future employer ought to know about what you have done or can do; refer him to men who can speak definitely and without reservations as to your ability and moral worth; then stop.

It should be noticed that no letter of application, however well written, will secure a position unless there is one to be had. For the last two or three years the bread line of engineers has been a long one. That the supply still exceeds the demand becomes evident by comparing the "Positions Wanted" with the "Positions Vacant" in the advertising columns of the technical papers. There are applicants by the score for every position vacant. The importance of the letter of application is apparent. This, however, is but one phase of a larger subject—the use of better English by engineers.

Schools Trying To Meet the Difficulty

In his preliminary analysis[1] of the replies received from 23,000 circular letters to engineers regarding the needs of the profession Professor Mann, of the Carnegie Foundation for the Advancement of Teaching, writes:

> In questioning the efficiency of the engineering schools at the present time there are four conspicuous things in which the professional men show a fair degree of unanimity. The first and most important is English. A large majority of the letters received mention the absolute necessity for higher efficiency in the training in English.

Some colleges are trying to meet this need. The Stevens Institute of Technology in its catalog for 1916-17 states: "No effort is spared to impress upon the students that their success as engineers will depend largely upon their knowledge and use of language." Attention is given to English and Logic throughout the college course. This seems more rational than to neglect them, claiming that these particular branches belong to the grammar and high schools. Where English is neglected because the course is already overcrowded with other subjects, something might be done by way of substitution. Often out-of-term and supplemental-reading courses could profitably be introduced.

In conclusion attention is called to the following books on the subject:

"Handbook of Composition," Wooley. This is an excellent manual on general composition.

"Handbook of English for Engineers," Sypherd. This should be studied by every engineer called upon to do business or technical writing.

"Engineering as a Vocation," McCullough. The six chapters of this book can be read with profit by every young engineer, especially Chap. V—"How to Hunt and Hold a Job."

"The Theory and Practice of Technical Writing," Earle, and "Good Engineering Literature," Frost, are of value to the engineer given to writing for the technical press.

[1] Bulletin of the Society for the Promotion of Engineering Education, Vol. VI, p. 100 (October, 1915).

Unit Cost Figures on Illinois State-Aid Roads

Between July 1, 1914, and Jan. 1, 1915, contracts were awarded for the construction of state-aid roads in Illinois on 74 different sections, with an aggregate length of 91.27 mi. The total contract price of the work was $1,116,952, or an average of $12,240 per mile of completed road. From Jan. 1 to June 30, 1915, additional contracts were let amounting to $466,271. An analysis of the cost of these roads by M. W. Watson, Assistant Engineer of the State Highway Department, was published in *Illinois Highways* for March-April.

The earthwork on the roads was comparatively light, averaging about 5,550 cu.yd. per mi., and the average cost of handling it was 28.9c. per cu.yd. An analysis of the prices of 50,000 lin.ft. of 10-ft. concrete roads shows that the price per square yard of pavement varied from $1.03 to $1.41, and averaged $1.21. On 64,000 lin.ft. of 15-ft. concrete roads, the contract price for the pavement proper varied from 92c. to $1.24 per sq.yd. and averaged $1.11. On 35,000 ft. of 18-ft. concrete roads, the price per square yard of pavement varied from $1.03 to $1.27, and averaged $1.20. On 21,000 ft. of 10-ft. brick roads the price per square yard varied from $1.65 to $2.05, and the average was $1.88. On 19,000 ft. of 18-ft. brick roads the price per square yard of pavement varied from $1.63 to $2.37, with an average of $1.85. The cost of macadam shoulders for concrete and brick roads varied from 39c. to 52c. per sq.yd. The cost of 7520 ft. of macadam roads averaged 51c. per sq.yd. of pavement. The cost of 27,806 ft. of gravel roads averaged 43c. per sq.yd. of pavement.

Field and Office

Winter Sewer Work at St. Paul

By George H. Herrold*

An unusually wet season in 1915 and the prospects of a large amount of work in 1916 induced Thornton Brothers Co., St. Paul, Minn., to give a thorough tryout to open-trench sewer work in winter weather. This firm was awarded the contract for the Snelling-Como sewer system by the City of St. Paul for $263,000. It signed the contract on Nov. 9, 1915, and immediately began moving its outfit on the job.

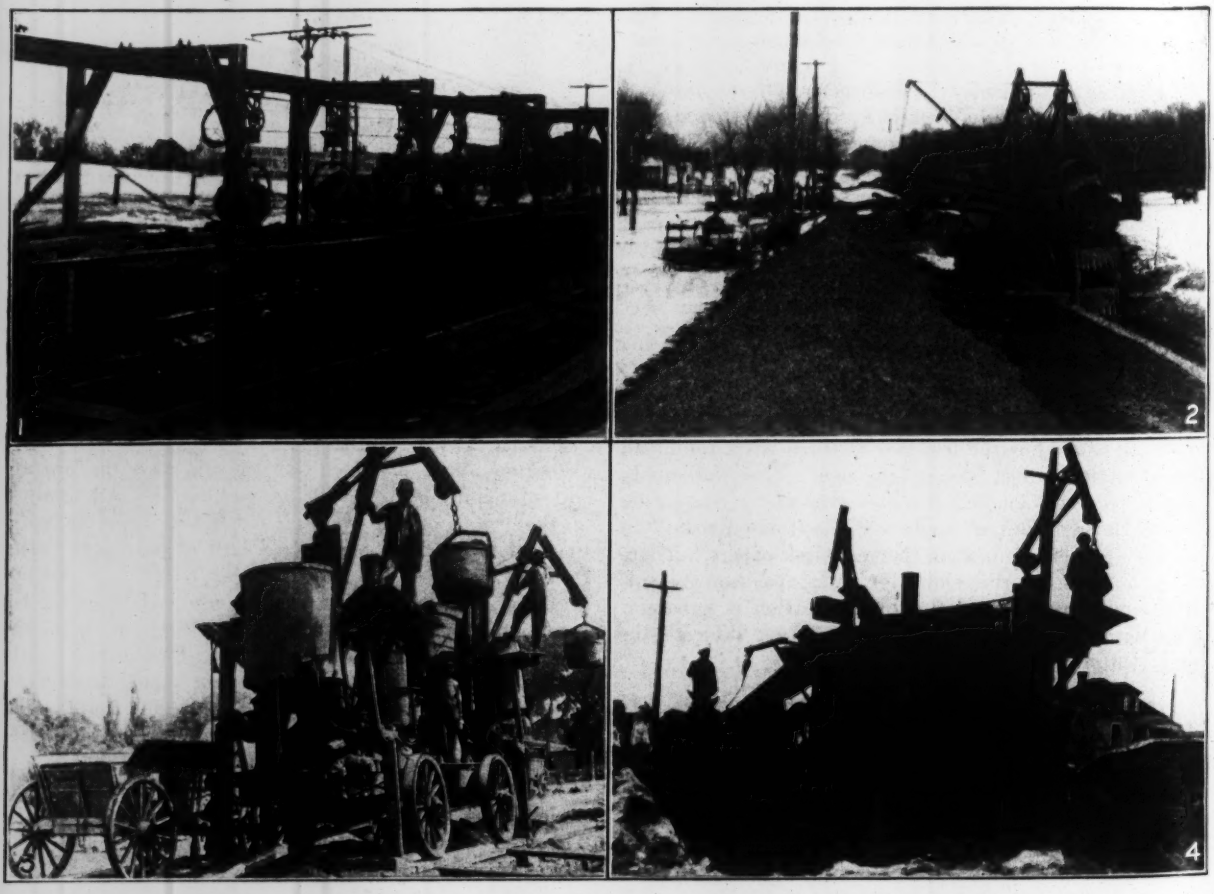
The system consists of approximately 13 mi. of mains and laterals. The main system consists of 3,196 ft. of 75-in. monolithic concrete sewer, 2,953 ft. of 66-in., 3,009 ft. of 54-in. and 1,354 ft. of 36-in. vitrified segment blocks; there are 11 mi. of 9- to 30-in. laterals.

The contract equipment consisted of two steam shovels, ⅞-yd. dipper, one Buckeye trenching machine, one Carson conveyor, two White bucket machines, 12 dump cars, a mile of narrow-gage track, 20 dump wagons, three gasoline trench fillers and a camp equipment for housing and feeding 175 men. The bunk house and dining room are equipped with electric light and city water.

The entire district drained by this system, which adjoins the State Fair grounds, is underlain with sand and gravel with an earth cap 2 to 4 ft. thick. Sheeting has been used on every foot of the work except about 600 ft. of the 11 mi. of laterals, all from 11 to 30 ft. deep. The ground was thawed by fires, using Illinois washed nut coal and some hardwood; the thawing crews worked nights. All of the laterals, 250 manholes, the 1,354 ft. of 36-in., 3,009 ft. of 54-in. and 750 ft. of 66-in. main were completed May 1, 1916.

Weather conditions were quite severe. During November, 4.7 in. of snow fell; in December, 6 in.; in January, 20.5 in., and in February, 4.5 in. There was no severely cold weather until after Jan. 1; that is, none below zero, but the light snowfall was little protection even in slightly freezing weather. On Dec. 15 there was a foot of frost

*Assistant City Engineer, St. Paul, Minn.



DIGGING SEWER TRENCHES IN ST. PAUL AFTER THAWING FROZEN GROUND

Fig. 1—Carson conveyor machine backfilling over 54-in. sewer. Fig. 2—Buckeye trenching machine on a lateral. Fig. 3—White trenching machine, with drop-bottom buckets on swinging crane to hold spoil. Fig. 4—White machine with chutes replacing buckets to reduce weight on trench side.

to thick through, and the contractors began thawing out the ground with fires. In January there were 16 days of below-zero weather, the lowest temperature being —31° F., and in February, 12 days, the lowest being —20°. Frost reached a depth of about 5 ft. Jan. 10. The snow was removed from the ground over the line of the trench by means of ordinary road graders.

The frost was taken out by starting a coal fire about half the width of the trench—in the case of small trenches—and 100 to 300 ft. in length. After the fires were well under way they were covered with semicircular corrugated iron strips to hold the heat to the ground. When the fires burned out the thawed material was picked out and another fire started in the bottom of the trench. The thawing proceeded until the gravel was reached.

For the large trenches three lines of fire were placed, one each at the outer edge of the trench and one down the center. A steam shovel mounted on heavy timbers spanning the three small trenches then broke out the cakes of frozen earth between them and continued digging in the gravel. Sheeting crews had to work between the dipper and the timbers that supported the steam shovel, driving 16-ft. lengths while the shovel excavated 10 to 12 ft. deep. The shovels were followed by the Carson conveyor or a White bucket machine completing the trench, another line of sheeting being driven inside the first as the trench was deepened.

The Carson machine was used on the 3,009 ft. of 54-in. sewer. Work was started on Dec. 7 and finished on Mar. 1. The depth of the trench for this sewer was from 15 to 31 ft. The machine consists essentially of a steam hoisting machine in a housing on wheels, following as close to the steam shovel as practical. It operates an overhead cableway on a rectangular framework supported on rails laid along each side of the trench, carrying 24 buckets, six in each set. While six buckets are in the trench being filled six are on the way to be unloaded, six are being unloaded and six are returning empty. The sewer is laid in the trench and the backfilling is made with these buckets from the excavation taken out in front of the pipelaying.

The White machine is a double-bucket hoist and will dig a trench 48 ft. long without moving. The bucket is raised and emptied into dump cars or dump wagons, and the spoil is hauled back to be used as cover for the completed sewer. It handles about 150 cu.yd. a day.

The Buckeye trenching machine digs to a depth of 14 ft. It dug 400 to 600 lin.ft. of trench a day. It was used wholly on laterals. Frost was thawed to a depth of 2.5 ft. ahead of the machine and 2½ ft. of frost was cut out with the machine.

The cost of thawing ran from 15 to 25c. per lin.ft. of fire.

The work has been very satisfactory from an economical standpoint for the contractors and very acceptable to the engineering department of the city. The contractor has had a full camp and no labor troubles and less delay from weather conditions than are ordinarily met.

Drainage-Ditch Design Tables

Hydraulic tables for use in designing systems of drainage ditches have been prepared by John C. Burke, civil engineer, of Bemidji, Minn., who sends the example shown herewith. The tables have been found very convenient in the rapid checking of ditch dimensions and the control of velocity. Quantities for Elliott's formula and for two coefficients of Kutter's formula are given to afford ready comparison with other designs.

The figures at the right, giving the cubic yards of excavation per mile of ditch of given size, serve as a useful check on selected sizes and grades with regard to economy in first cost of system.

HYDRAULIC TABLES FOR DRAINAGE-DITCH WORK

Base	Depth	Top	Area	Wet Perimeter	Hyd Radius	Grade, %	Velocity, Kutter's n 0.025	Velocity, Kutter's n 0.030	Discharge, Ell	Sec.-Ft n 0.025	Sec.-Ft n 0.030	Cu Yd per Mi
4	3	10	21	12 5	1 7	0 02	1 2	1 0	34	25	21	4,107
..	..	..	..	..	..	0 04	1 7	1 3	46	36	27	..
..	..	..	..	..	..	0 06	2 1	1 7	54	44	36	..
..	..	..	..	..	..	0 08	2 4	1 9	64	50	40	..
..	..	..	..	..	..	0 10	2 7	2 2	77	57	46	..
4	4	12	32	15 3	2 1	0 02	1 4	1 1	58	45	35	6,258
..	..	..	..	..	..	0 04	1 9	1 6	82	61	51	..
..	..	..	..	..	..	0 06	2 4	1 9	98	77	61	..
..	..	..	..	..	..	0 08	2 8	2 2	114	90	70	..
..	..	..	..	..	..	0 10	3 2	2 5	130	102	80	..
4	5	14	45	18 2	2 5	0 02	1 5	1 3	90	68	59	8,800
..	..	..	..	..	..	0 04	2 2	1 8	130	99	81	..
..	..	..	..	..	..	0 06	2 8	2 2	160	126	99	..
..	..	..	..	..	..	0 08	3 2	2 5	180	144	113	..
..	..	..	..	..	..	0 10	3 5	2 8	200	156	126	..
4	6	16	60	21 0	2 9	0 02	1 7	1 4	130	102	84	11,740
..	..	..	..	..	..	0 04	2 4	2 0	180	144	120	..
..	..	..	..	..	..	0 06	3 0	2 5	220	180	150	..
..	..	..	..	..	..	0 08	3 4	2 8	255	204	168	..
..	..	..	..	..	..	0 10	3 9	3 2	285	234	192	..
4	7	18	77	23 0	3 2	0 02	1 8	1 5	175	139	115	15,060
..	..	..	..	..	..	0 04	2 6	2 2	240	200	169	..
..	..	..	..	..	..	0 06	3 2	2 6	300	246	200	..
..	..	..	..	..	..	0 08	3 7	3 0	350	285	231	..
..	..	..	..	..	..	0 10	4 1	3 3	390	316	254	..
4	8	20	96	26 6	3 6	0 02	2 0	1 7	225	192	163	18,780
..	..	..	..	..	..	0 04	2 8	2 4	320	269	230	..
..	..	..	..	..	..	0 06	3 5	2 9	390	336	278	..
..	..	..	..	..	..	0 08	4 0	3 3	450	384	317	..
..	..	..	..	..	..	0 10	4 5	3 7	508	432	355	..
4	9	22	117	29 4	4 0	0 02	2 2	1 8	293	257	211	22,890
..	..	..	..	..	..	0 04	3 1	2 5	415	363	292	..
..	..	..	..	..	..	0 06	3 8	3 1	510	444	363	..
..	..	..	..	..	..	0 08	4 4	3 5	590	514	409	..
..	..	..	..	..	..	0 10	4 9	4 0	660	573	468	..

Ruptured Floor-Beam Stirrup Drops Bridge Floor

An unusual and somewhat obscure accident to a steel highway bridge is recorded in the January-February issue of *Illinois Highways*, the bulletin of the State Highway Department. Two panels of the floor of a truss bridge over the Spoon River in Persifer Township, Knox County, fell by fracture of one of the stirrup floor-beam hangers, while a traction engine was crossing the bridge. The engine, said to have weighed 12 tons, was pulling a tank wagon and a corn sheller, and apparently these loads were so grouped over the two failed panels, at the moment of failure, as to give something near maximum floor-beam reaction. The county highway superintendent says, as to circumstances and cause:

> **The temperature was about 10° above zero and the river was covered with about 6 in. of ice. The bridge, which had been repaired and painted three years ago, was supposedly in good shape. This same engine had crossed it several times before. It is presumed that the cold weather had weakened the stirrup to such an extent that it snapped when the sudden strain, caused by the weight of the engine, came upon it.**

While the above cold-weather explanation of the failure cannot be accepted, no satisfactory explanation is possible in the absence of details of the ruptured hanger.

The bridge was built in 1898, at a time when there was no state supervision of highway bridge construction in Illinois. Under these circumstances, and with floor suspended by U-stirrups, the bridge was probably not free from local overstress due to secondary bending. Such overstress in the stirrup might result in rupture under a load which had previously been carried in safety, as happens in old chains and other highly-stressed working parts.

Autographic Cross-Sectioning by a New Instrument

By John Airey*

In earthwork construction there is a vast amount of duplication work when cross-sectioning. The appraisal of the railroads is an example. Cross-sections have to be taken every 100 to 500 ft. The stupendous amount of repetition work in this job alone, carried through for 280,000 mi., is readily imagined. If a field party of three does 4 mi. per day, with two computers in the office, the total cost to cross-section all our railway track is over $1,000,000. Add to this the amount of cross-sectioning in irrigation construction, new railway location, highway grading, etc. It is evident that, if a mechanical device could be used to reduce the repetition of like operations in cross-sectioning, a colossal saving

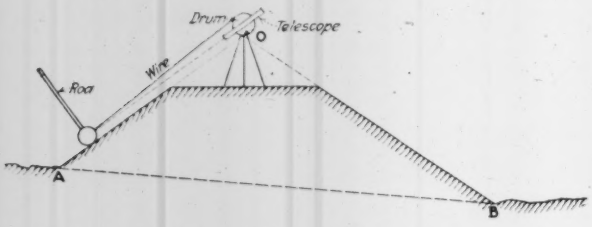


FIG. 1. OUTLINE SKETCH OF THE KEELER CROSS-SECTIONING DEVICE

would result. The writer proposes to trace the development of instruments for this purpose and to give details of one possible solution with its limitations.

In taking a cross-section of a proposed railway route or of the embankment of an existing one the problem consists in recording sufficient observations so that the contour may be reproduced on paper and the area of the cut or fill, or proposed cut or fill, determined. This area is determined either by planimeter or computation. In attempting to render some of this work automatic the first thing most people have done is to get a small-scale reproduction directly.

*Assistant Professor of Engineering Mechanics, University of Michigan, Ann Arbor, Mich.

In one instance this has been accomplished by placing an instrument well away from the cross-section, successively pointing the telescope at different points on the contour and recording the motion of the telescope by pricking holes in a sheet of paper vertically placed. Joining these holes gives a drawing of the contour, which may then be planimetered. No measuring is required except the distance from the instrument to the cross-section, which determines the scale of the reproduction.

In another device the instrument is placed in the plane of the cross-section and shots are taken at various points. The distances to these points are determined by stadia measurement. Marks are made on a sheet of paper; when joined up, they give the contour. Briefly put, the section is plotted using polar coördinates, the telescope finding the angle and the stadia the radius vector.

These instruments do not go far enough. They do not get the area, nor do they even get a contour until the points have been joined up by hand; and this contour is only approximate, being a series of straight lines.

There is another type of instrument, which does not attempt to provide a scale drawing, but gives an area reading. One of these (Patent 1,129,872, Karl F. Keeler) is suggested diagrammatically in Fig. 1. Two operators are required. One operator, holding the rod, rolls the pulley attached to its end over the cross-section. A wire is fastened to the axle of the pulley. The wire is reeled off a drum, being kept taut by a spring. The second operator, at the instrument, keeps the telescope continuously lined up with the end of the wire. The area swept out by the wire being dependent on length and angle, suitable mechanism records this area. The area of fill is, however, the difference between the area swept out by the wire and the area of a triangle. This entails the measurement of AO, OB and angle AOB, which the machine is arranged conveniently to do. The area of the triangle must then be computed.

The chief objection here is that accuracy depends on efficient coöperation between the two operators. With practice this would not be difficult, but the fact that any momentary lack of teamwork can cause inaccuracy is undesirable.

The next type of instrument eliminates this teamwork. This instrument (Patent 1,170,721, John Airey) is fairly

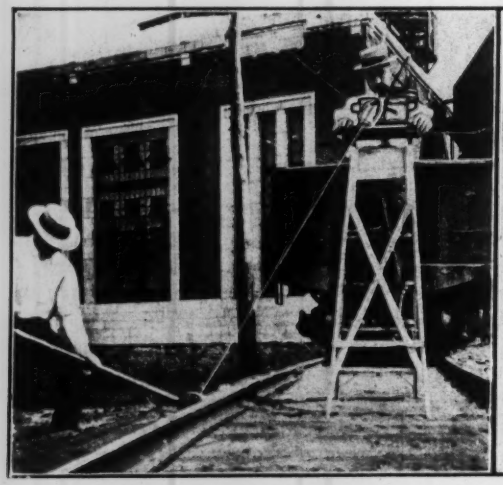


FIG. 2. TAKING A RAILWAY CROSS-SECTION WITH THE NEW INSTRUMENT

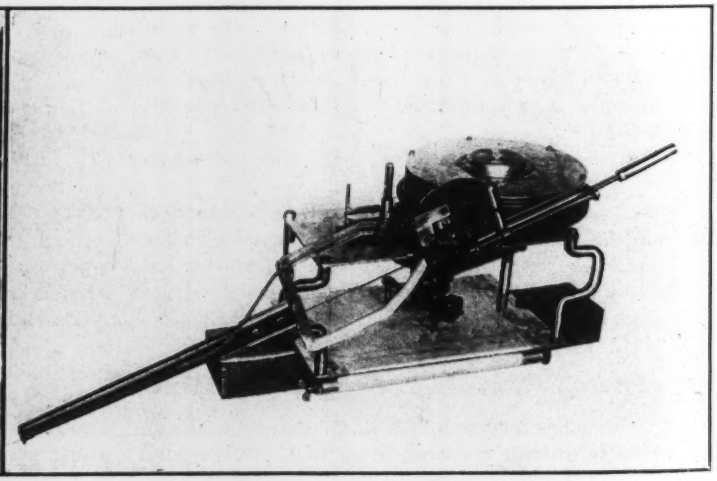


FIG. 3. MODEL OF AIREY-KEELER CROSS-SECTIONER

similar in principle to the last described, except that the taut wire in addition to giving a record of length is made to control the directive element too—that is, does the work of the telescope. The accuracy is thus self-contained, the instrument operator being required merely to take readings.

These two instruments find the true area, not an area bounded by straight lines. However, their weakness is that no graphical record of the section is made, and this is usually desirable and sometimes necessary.

The last type of instrument is one in which a graphical record is automatically obtained, also the true area of the cut or fill, without any computation whatever and without readings except final area. This instrument (Patent 1,174,649, March, 1916, John Airey and Karl F. Keeler) is shown in Fig. 3 (a model). Fig. 2 shows this same model in operation in the field, an ordinary stepladder being used as a stand.

The principle may be followed from Fig. 4. Here a tripod is seen standing on the roadbed in a cut. The instrument is shown disproportionately big for clearness. The maximum dimension of the instrument is 10 in.; its weight is less than that of a level. Two spools carry a roll of paper, the paper passing over a table. Thus the various cross-sections taken are kept in natural sequence on a continuous roll. The wire attached to the rod is unwound from the drum, in which there is a coil spring. Also the wire, passing through an eyelet in the arm, causes the latter to point at the rod. A pencil resting on the paper is swung around by the arm and at the same time is moved radially outward by the wire drum, so that it gives an exact reproduction of the cross-section of the embankment. The pencil also acts as the pointer of a planimeter from which the area is read off.

The closing side *CB* of the cross-section is completed by pressing a catch that disconnects the pencil and the planimeter from automatic control and by then drawing the line along a straight-edge laid against points *C* and *B* on the paper.

An important feature is the elimination of error due to varying sag of the wire, as the span of the wire varies. A small balance weight on the arm, Fig. 5, is automatically controlled so that the arm is always pointing true to the free end of the wire. The scheme employed, though simple, can be demonstrated to be theoretically perfect, and practical tests have failed to detect any deviation from correct alignment of the wire.

The foregoing discussion has reference to embankments or excavations already made. One of the chief uses of this instrument will be in the preliminary estimates of cuts and fills. The decreased expense with which this can be done will make estimates of alternative routes possible in a way that does not exist at present.

An outline of the possibilities in this kind of work is suggested in Fig. 6. It is required to set slope stakes and compute cut and fill for a canal whose center line has been located. The straight-lined contour is a celluloid templet cut to the shape of the finished canal and correctly positioned on the instrument table, which is done quickly by pressing the left side of the templet against a scale of elevations. An outline of the templet is then marked on the paper. The operator holding the rod traverses the ground line *ABC*, which the instrument reproduces on the paper. As the instrumentman observes this line cross the templet lines, he signals the positions where the stakes must be driven. The instrument operator now runs the pencil round the templet lines and reads the areas of cut and fill.

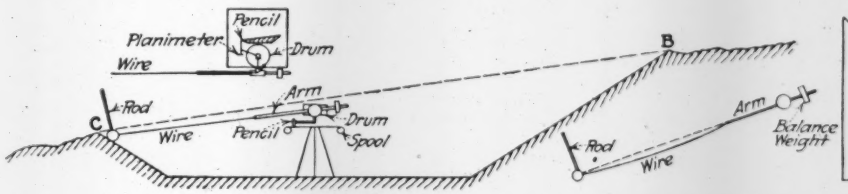


FIG. 4. DIAGRAM OF AIREY-KEELER CROSS-SECTIONER IN A RAILWAY CUT

FIG. 5. METHOD OF CORRECTING FOR SAG OF WIRE

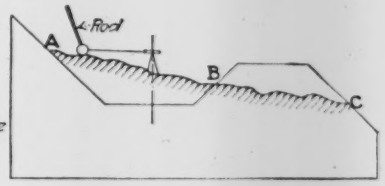
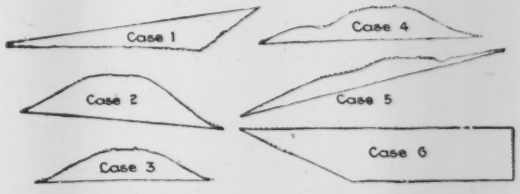


FIG. 6. HOW TO SET SLOPE STAKES

It is probable that various advantageous uses would develop in the course of practice for such an instrument in combination with templets. Some tests of the model to give a line on the convenience and workability of the scheme yielded the results shown in Fig. 7. There is good evidence to justify the belief that even this comparatively crude model is more accurate than rod-and-level methods (for example, notice that even the steel rails are evident in the diagram). With an instrument made by a reputable instrument maker, an accuracy of under 1% would easily be obtained.



	Cross-section Meter,		Planimeter,			
	First Reading, Sq.Ft.	Second Reading, Sq.Ft.	First Reading Sq.Ft.	Second Reading, Sq.Ft.	Maximum Difference, %	Minimum Difference, %
Case 1.....	278	283	279	279	1.4	0.36
Case 2.....	319	325	327	328	2.45	0.76
Case 3.....	205	209	202	204	3.25	1.97
Case 4.....	252	253	247	251	1.6	1.2
Case 5.....	200	195	198	200	2.0	0.5
Case 6.....	729	719	692	695	5.1	3.56

FIG. 7. COMPARISON OF AIREY INSTRUMENT AND ROD-AND-LEVEL RESULTS ON FOUR FILLS AND TWO CUTS

Dotted lines are plotted from level readings; full lines are drawn by instrument. Note how the instrument catches minor irregularities like the rails.

As to speed of work, the reader may form his own judgment of comparative times required in merely walking over the embankment at say 2 mi. per hr., then back to the instrument, compared with the time required by present methods to take the necessary number of shots in the field, then the subsequent plotting and planimetering.

This type of instrument will not handle all cases. The chief restriction in all the instruments using a wire is that the instrument must be so placed that a straight

line may be drawn in air from it to all parts of the contour—that is, the instrument must be able to see down the slopes. This restriction applies only in surveying embankments already built.

It is planned to use this instrument on a tripod whose two back legs have crosspieces like a stepladder; the instrumentman by standing 4 ft. above the ground would be in a convenient position to handle the instrument when high enough for a double-track fill.

Another limitation is that the contour must be such as can be traversed by the end of the wire. Precipitous cliffs are thus ruled out, or when the contour is very deep under water. Heavy brush might be troublesome and in extreme cases rule out the use of the instrument, but the fact that a zigzagging path to the extent of a few feet may be indulged in without error in reading will enable all but the extreme cases to be handled.

Finally, the limitation of magnitude arises. A big freight-yard would clearly be out of the scope of the instrument. The model shown has a 50-ft. wire, which means capacity to take a track nearly 100 ft. wide, or nearly all double-track roadbeds. A 75-ft. wire could just as easily be accommodated, which would amply suffice.

As roads of three and four tracks form a negligible proportion of the total mileage of the country (1.6%), there should be a big field for this instrument in appraisal work. New location—whether for railways, canals or highways—also offers large opportunities. Indeed, highway location is probably the most important field of all. There is every evidence that the great development in improving means of transportation will in the next decade be in the construction and improvement of highways.

Considering the above fields of employment, and remembering that 5 men (3 field men and 2 computers) are replaced by 2; also that these two make greater speed and increased accuracy, the writer refrains from attempting an estimate of the saving effected, as it might seem rash.

Measuring Yardage of Granite Blocks by Weight

To arrive at a new basis for settling with the producer for shipments of granite blocks in carload lots, weights and counts of 19 carloads were recently made under the direction of Charles H. Clark, Engineer of Maintenance-of-Way, Cleveland Railway Co., Cleveland, Ohio. Mr. Clark states that the only right way to purchase granite blocks is by the thousand, but that they are more often bought by the square yard.

The specifications generally stipulate that there shall be a certain number of blocks per square yard and that a test of each carload shall be made. In such test there is always chance for an error on one side or the other, and after a number of carloads have been thrown into a common pile there is no way of making a recount to settle differences between the shipper and purchaser. With a freight rate of $2.58 per ton, and also taking into account the cost of the blocks themselves, a difference of 5 or 10 yd. per car mounts up in the course of a season.

The plan followed by Mr. Clark was to determine the weight of blocks in each carload, then fill an 8-yd. frame with blocks, count the number of blocks, and find their weight. It was found that for 18 of the 19 carloads (marked weight being taken for one carload for tare) the corrected weights of the cars themselves were less than the marked rates in 16 instances, the excess or basis of overcharge running as high as 4,100 lb. in one case, 2,000 in another, and on down to a few pounds. For two cars only was the corrected weight in favor of the shipper. The number of blocks in an 8-yd. frame ranged from 240 in two cases, with weights of 4,400 and 4,150 lb. per frame, to 218 blocks in one frame weighing a total of 4,280 lb.

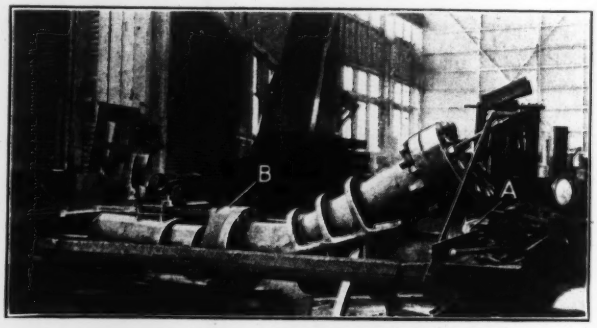
A weight of 535 lb. per sq.yd. of granite blocks was established as the result of the tests, as compared with 26 blocks per sq.yd., or a weight of about 485 to 500 lb., according to the shipper's claim.

The specifications under which the paving blocks were bought by the Cleveland Railway Co. for paving work between tracks called for blocks with lengths of 8 to 12 in., widths not less than 4 in. nor more than 5 in. and depths not less than 5 nor more than 5½ in.

High-Pressure Test of Pipe with Unbolted Flanges

By J. W. Swaren*

Seventy-three cast-steel branches were required for station connections in an oil pipe line recently built in California. These branches were tested to 2,000 lb. pressure for twenty minutes in the shop of the Pelton Water Wheel Co. The method of performing these tests was unique.



HOLDING OIL-PIPE SPECIALS IN PRESS WHILE TESTING

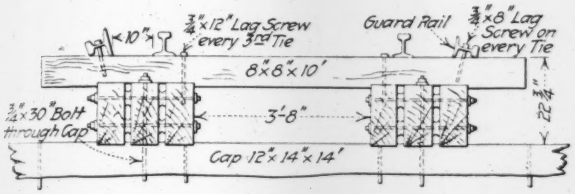
A hydraulic jack which is ordinarily used in field work for pressing on flywheels and rotors was blocked up in a framework made of structural shapes. A blank flange was rested against the head of this framework, as shown at *A* in the photograph; another blank flange shown at *B* was rested against the head of the jack. A third blank flange was bolted to the branch flange of the pipe section, and the latter was picked up by a crane and put in place between the two blank flanges in the frame, with a piece of stencil-board as gasket. Applying 500 lb. pressure to the jack, the two unbolted end flanges were held on tight enough to resist the thrust due to the test pressure inside the pipe.

The sections have a bore of 8 in. and weigh 1,250 lb. each. The testing was done by two helpers under the direction of an inspector, at the rate of 10 sections per day. The 73 branches were supplied by the Best Steel Casting Co., and not a single one proved defective during the test. These tests were made after all machine work had been completed.

*Hayward, Calif.; R.R. 2, Box R.

Bridge Floor with Old Rails for Outside Guards

Steel guard rails for bridge floors, placed outside the track rails and used instead of the usual outside guard timbers, are standard practice for bridges and trestles on the Atlanta & West Point R.R. and the Western Ry. of Alabama. Old rails are used, laid on their sides, with the base 10 in. clear from the base of track rails, as



OLD-RAIL GUARD ON BRIDGES OF ATLANTA & WEST POINT R.R.

shown in the drawing. At the ends of the bridge the guard rails are flared away from the track. Each guard rail is fastened to every tie by a ¾-in. lagscrew 8 in. long. No inside guard rails are used. This construction has been followed for some years with satisfactory results, and in cases of derailed trucks it has guided them safely across the structure. Information has been furnished by O. T. Nelson, Superintendent of Maintenance-of-Way, Atlanta, Ga.

Large Reinforced-Concrete Mat Building-Foundation

A mat foundation is to be used under rather unusual conditions in the case of a factory and warehouse building to be constructed for Wyman, Partridge & Co. in Minneapolis, Minn. The building is to be a 12-story structure of reinforced concrete, 108x162 ft. in plan. The column spacing is arranged to give large bays—19 ft. 10 in. by 26 ft. 2 in.—and the loading is fairly heavy. Kees & Colburn are the architects.

Soundings to a depth of 100 ft. failed to strike rock, an unexpected condition. The soil encountered was clay with loam and a very fine, unstable sand. A preliminary design for spread footings resting in this soil showed that a footing would be almost as large as a bay and would be of considerable depth. It was then decided that the footings should be made continuous, as by such construction also the necessity of keeping the foundations within the property line could be provided for without cantilevering for the support of the outside walls.

In accordance with this decision a full slab or mat 108x162 ft., 5 ft. in thickness under the outside walls and 4 ft. in thickness under the interior, and with four-way reinforcement both top and bottom, was designed. On this mat rest stepped pedestals 12 ft. square by 2 ft. thick and 5½ ft. square by 2 ft. thick, supporting the column bases.

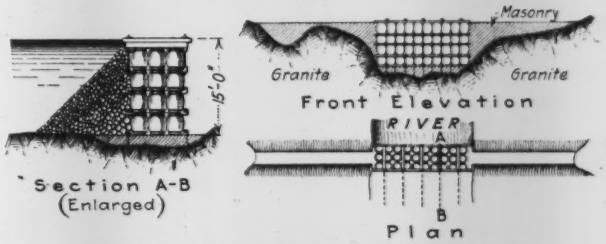
The building columns are in general of reinforced concrete, but in the lower seven stories space is saved by making them of steel sections incased in concrete. A heavy basement column consists of four 6x6x⅞-in. angles, six web plates 13x⅞ in., six flange plates 20x¾ in., and two flange plates 20x⅝ in.

NOTES

A Steam Shovel with Grab Bucket is digging a sewer trench 21 ft. deep in Cleveland, Ohio. A 3x5-ft. brick sewer, with 16 ft. of cover, is being built, the excavation being accomplished by an Osgood 18 equipped with a special boom and an Owen grab bucket. The muck is carried away by a Lakewood car, as shown in the view which was taken at the junction of East 9th St. and Orange Ave. The plant has several interesting features—one is its compactness, and another is the small amount of manual labor required. Bricklayers can follow close behind the excavation, and the backfill must be transported only a short distance before dumping. In addition to the economical aspect of this method only a short stretch of street is obstructed. The work is carried on in sand, and sheeting is set as needed. The head of the trench is sheeted, as the view shows. William McDowell is the contractor.

STEAM SHOVEL WITH GRAB BUCKET DIGGING A 21-FT. SEWER IN CLEVELAND, OHIO

A Dam Made of Oil Barrels has been built in northern Nigeria to help form a dredging pool used in mining operations. The dam is 15 ft. high and is formed of 120 of the steel barrels in which oil fuel is brought to the site. Other suitable dam materials are very scarce. The barrels are arranged as shown in the sketch and are filled with sand to give weight. They are tied together with timber plates, filled in between with broken granite and tied back upstream with slanting steel tie-rods. The upstream side of the dam is backed with broken rock, the filling being graduated in size from coarse rock next the barrels to fine rock and finally sand and earth. The dam is described in a paper before the Institution of Mining and Metallurgy, by H. E. Nicholls.

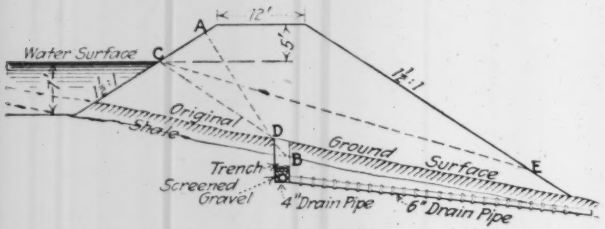


STEEL OIL BARRELS FORM CORE OF DAM

Scrapping Old Iron Bridge—The Cumberland Valley R.R. several months ago sold to a local junkman the old Potomac River Bridge, the seven spans of which were replaced by plate girders on concrete piers about 1½ yr. ago. The old trusses, built by the Union Bridge Co., in 1889, were about 150 ft. long each and placed 50 ft. above low water. When the bridge was demolished, the water in the river was from 4 to 10 ft. deep. Wreckers cut up the floor system with flame

and threw the trusses into the river, from which they were later fished up and burned to sizes convenient for handling with a small roughly built derrick. Practically the only plant employed consisted of this derrick, a hoisting engine and a push car. The wrecking was done without falsework. Under favorable conditions six men were able to take down a span per week and load it for temporary disposal. River conditions, however, were such that the work proceeded on half time only.

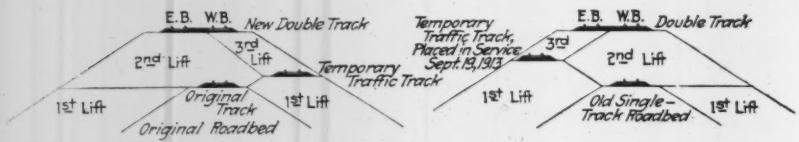
Tile Drainage for Canal Embankments on sidehill location has been introduced to a considerable extent on the Grand Valley Project of the United States Reclamation Service in Colorado. The accompanying illustration shows a typical installation on the main canal, Divisions 3 and 4 of the project.



SYSTEM OF TILE DRAINAGE FOR IRRIGATION-CANAL EMBANKMENTS ON SIDE HILLS

The line CE indicates the probable location of the upper surface of the saturated portion of the embankment, if no underdrainage is provided. With an embankment on a sidehill slope like this, settlement and sliding are apt to occur, along some plane as AB. The tile subdrainage is expected to lower the plane of saturation to CD, keeping the toe dry and preventing sliding or sloughing. A longitudinal drain is laid a little downhill of the center line of the embankment location, of 4-in. vitrified clay pipe laid on 0.01 slope or greater, at a depth of 2 to 3 ft. below ground and surrounded by 12 in. of screened gravel. At intervals this longitudinal tile is drained by a transverse 6-in. tile laid with tight joints. On this project the total length of these drains was 3,184 lin.ft., and the total cost, including excavation, screened gravel and pipe, was 37c. per lin.ft. The work was done under the direct supervision of Fred J. Barnes, Assistant Engineer. J. H. Miner is Project Manager.

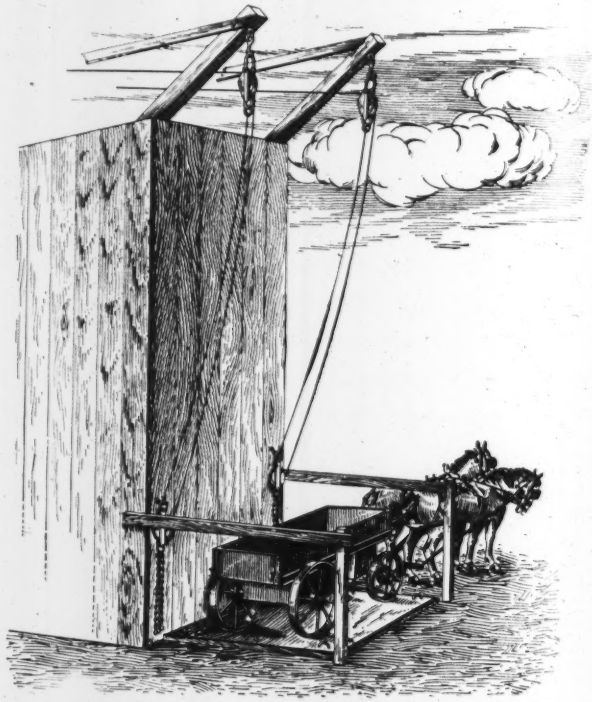
Raising the Embankment Approach to the Atchison, Topeka & Santa Fe Ry. bridge over the Missouri River above Kansas City, known as the Sibley bridge, was accomplished without interruption to traffic by the method shown in the right-hand sketch. The grade of the approach was reduced from



(LEFT) PROPOSED AND (RIGHT) ACTUAL METHOD OF RAISING FILL OF SIBLEY BRIDGE APPROACH, SANTA FE RY.

0.8% to 0.5%, the total height of fill added being 11 ft. Besides, the embankment was widened for two tracks. The changes were completed late in 1915. On account of a continued dry spell in 1913, while the work was in progress, the lift was made in two stages, as shown at the right, instead of in three stages, as proposed originally. R. A. Rutledge is Chief Engineer of the Eastern Lines of the Santa Fe, and G. J. Bell, now District Engineer at Newton, Kan., was engineer in charge of the work described.

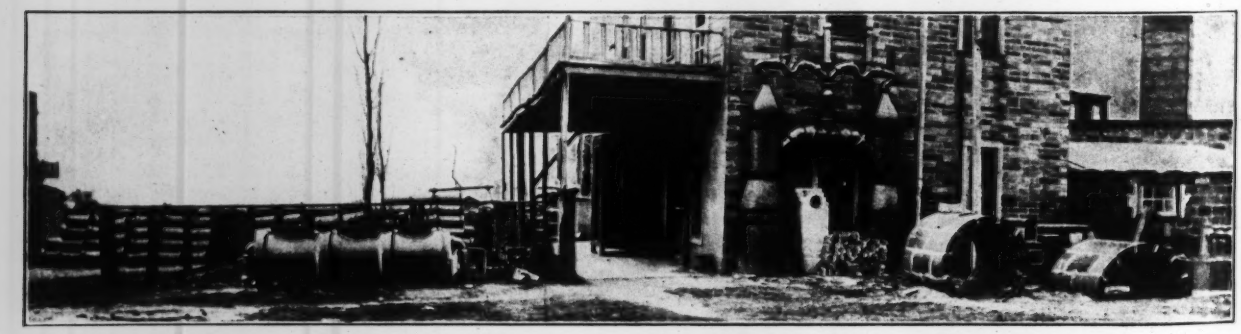
Putting Sand in High Bins of the concrete plants for the new Plankinton Hotel now under construction in Milwaukee, Wis., requires that the material be elevated about 40 ft. This is accomplished by the platform lift shown in the



A SAND-HOISTING PLATFORM IN MILWAUKEE

sketch. The sand is delivered on the elevator by wagons. It is dumped, the wagon is driven off, the hoisting hooks (three to each end) are attached, and the elevator is raised until one edge contacts with the lower part of the hoist beams. The platform pivots about this edge until stopped by the beams, the sand sliding off into the bin. This loading scheme is used at both of the concrete plants on this job. The contractors are W. J. Hoy & Co., of St. Paul.

A Permanent Exhibit of Clay Products—The office of the San Antonio Sewer Pipe Works, about 30 mi. south of San Antonio, Tex., is arranged as a permanent exhibit of clay products. In the left-hand foreground of the view herewith is a clay-pipe septic tank. To the right are sewer-pipe specials—reducers, bends, elbows, etc. Below are chimney flues, and in the foreground are segmental-block sewers. The semicircular arch on the right rests on an invert interlocking flat block. All the buildings of the plant are constructed of hollow tiles.



PERMANENT EXHIBIT OF CLAY PRODUCTS, SAN ANTONIO SEWER PIPE WORKS, TEXAS

Editorials

Highway Foundations and Motor Trucks

It may be said without fear of contradiction that there is no state in the Union where the state highway work has been more thoroughly and scientifically done than in Massachusetts. Not only was Massachusetts the first state to embark on a large scale on highway construction with state appropriations, but the engineers who gained their experience in highway work there in the early days have been the leaders in good road construction in many other states.

It is of especial interest, therefore, to learn that the damage done to Massachusetts state highways during the past winter by motor trucks and motor omnibuses is far in excess of anything ever before experienced there. According to information from Col. William B. Sohier, Chairman of the Massachusetts Highway Commission, the worst damage occurred in January, when a long continued thaw drew the frost out of the ground, leaving it very soft. At this time a great many miles of the oldest state highways were broken through by motor trucks. The vehicles actually went through the road crust and sank up to their hubs. Some of the older state roads which hitherto always had carried traffic satisfactorily and been kept in good condition by oiling were so badly cut up that they looked like plowed fields.

Most of the macadam roads that thus suffered were waterbound macadam roads 12 to 24 years old and in most cases without a telford foundation. When Massachusetts first began state road building, the traffic was generally light and where the roadway was of sand or gravel it was not generally deemed necessary to use a telford foundation. Many of these roads have been kept in good condition for traffic by patching and oiling but have never been resurfaced with additional stone to make up for the wear. It is evident that they were worn too thin to stand the load upon them under the conditions stated.

What to do in the situation is a difficult problem. Massachusetts has built about 1,100 mi. of state highways. Several hundred miles of the older main routes undoubtedly should be resurfaced with at least 3 in. of stone to give them the requisite thickness to stand heavy traffic. The appropriations available for this work, however, are sufficient to widen and resurface only about 70 mi. a year, which probably does not keep pace with the wear and tear that is taking place.

The matter is of especial interest at this time when states, counties, and probably the Federal government are about to invest a larger amount of money in good road construction than ever before. The responsibility lies upon engineers to say how these roads shall be built and what foundations shall be provided for them. As has been recently pointed out in these columns, it is well nigh impossible to say what foundation conditions ought to be established without knowing what weights of vehicles are to run over them and at what speeds. The motor-truck enthusiasts are fond of declaring that it is the business of the public to build roads capable of carrying a vehicle of any weight, at any speed. The engineer, however, is faced with the difficulty of making a limited appropriation cover a certain number of miles. This appropriation, moreover, in many cases is borrowed money which a future generation must pay; and unless the foundations of the road are made secure, the road is likely to be destroyed long before the debt comes due.

In view of the damage done to the macadam roads of Massachusetts this spring, Colonel Sohier is of the opinion that it may become necessary to substitute some form of permanent pavement in place of macadam even on the country highways.

Scientific Explanation Is Not Invention

An interesting decision has recently been rendered by the United States Circuit Court of Appeals for the Second Circuit in a suit for the infringement of a patent on waterproofing paint. It is a well-known principle of patent law that an inventor's right to a valid patent is not barred because he does not fully understand or does not fully explain in his specifications the scientific principles on which his invention is based. In the case just decided the court laid down the further principle that in order to invalidate a patent on an invention it is not necessary that an earlier inventor who made the same invention and secured the same results should understand the scientific principle on which he was working.

The suit in question was one brought by Henry M. Toch and Maximilian Toch against the Zibell Damp-Resisting Paint Co. The case was decided in favor of the defendant by the Court of Appeals on Feb. 21, 1916, but the plaintiffs were granted a rehearing. The court has now reaffirmed its original decision.

The court based its original decision in favor of the defendant on its belief that the defendant had made public use of the invention more than two years prior to the date of the plaintiff's patent application. In petitioning for a rehearing the plaintiff's attorneys set up the claim that use without knowledge does not make a patent void. In other words, that even if Zibell accidentally and without intention produced a paint which had the same effect that was afterward obtained by Toch's preparation, it should not be a bar to the validity of Toch's patent, since Toch for the first time revealed to the public in his patent the scientific basis on which such paints could be fabricated and produced with certain knowledge as to their results.

The case of prior public use which was relied upon by the defense was the painting of the masonry walls of an underground squash court on the Blair country estate at Peapack, N. J. The court in its decision describes the use of the Zibell paint on these walls and then lays down the principle previously referred to, as follows:

Various attempts had been made to paint these walls and all of them proved unsatisfactory, as it had been found impossible to make any of the paint which they could get hold of stick on the walls. In the spring of 1903 the civil engineer in charge of all Mr. Blair's construction work noticed in "Engineering News" an advertisement of Zibell's product which in effect stated that the Zibell Damp-Resisting Paint Co. could furnish paints in various colors which would be guaranteed to resist dampness when applied to walls. Thereupon he obtained several gallons of a material known as Protectorine and applied the same to the wall with results which were entirely satisfactory, the original paint being still on the walls at the time of the trial of this case.

As it is not necessary in order to sustain a patent that the inventor should understand the scientific principle which underlies his invention, it is also not necessary in order to invalidate the patent to show that one who made use of the same process to accomplish the same result prior to the patent understood the scientific principle.

The Bell telephone transmits speech by transmitting it by means of electricity. But precisely how electricity operates under Bell's process or what form it takes, neither Bell nor anyone else knows. But that fact did not affect his right to obtain his patent. [Telephone Cases; 126 United States, 1 (1887).] The scientific principle is no part of the process for which a patent is granted and does not need to be set forth. [Emerson vs. Nimocks; 99 Federal, 737 (1900). Eames vs. Andrews; 122 United States, 30 (1886).]

Toch may understand better than Zibell the scientific principle involved in the process. He states in his specification:

The acid filler above described reacts with the calcium compounds in the outer portion of the cement construction to form a hard resinate or other organic calcium salt, which serves as an efficient protective layer and which is reinforced by the second or exterior coating.

And there is much in the brief submitted by his counsel on the chemical effect of the Toch mixture on a portland-cement construction. But chemical reactions as such are not patentable as a process.

We do not think that the fact that Zibell did not tell the public how to make Protectorine, as he would have had to do if he had applied for a patent, but kept its composition secret, precludes him now from defending a suit for the infringement of a patent, taken out subsequently for a like process accomplishing a like result.

The Increase in the Corps of Engineer Officers

The present authorized strength of the Corps of Engineer officers of the U. S. Army is 248. The army reorganization bill, signed by the President, June 3, provides for an increase in the number of officers of the Corps of Engineers to 505. The following table shows the number of officers authorized in each grade under the present organization and under the new organization:

COMMISSIONED OFFICERS OF THE CORPS OF ENGINEERS

Present Organization	New Organization
1 Brigadier-General (Chief of Engineers)	1 Brigadier-General (Chief of Engineers)
15 Colonels	23 Colonels
22 Lieutenant-Colonels	30 Lieutenant-Colonels
51 Majors	72 Majors
60 Captains	152 Captains
56 First Lieutenants	148 First Lieutenants
43 Second Lieutenants	79 Second Lieutenants

The enlisted engineer troops are to be proportionately increased as follows: Under the present army organization the enlisted force of the Corps of Engineers consists of three battalions. Under the new law the engineer troops are to include seven regiments and two mounted battalions, and as each regiment is made up of two battalions, there will be sixteen battalions in place of the three authorized by the old law. Under the new law, however, each battalion is to consist of three companies, whereas under the old law there were four companies to each battalion. It will be evident that the increase in the number of engineer-officers is necessary to provide for the increase in the engineer troops.

The increase which the act provides for is to be made in five annual increments as nearly equal as possible. It will of course be necessary in order to obtain the number of officers required for the largely increased army, that a large number of men from other sources than West Point must be given commissions. The act provides that vacancies in the grade of Second Lieutenant in any fiscal year are to be filled by appointment in the following order: (1) Graduates of West Point; (2) enlisted men, whose fitness for promotion is to be determined by a competitive examination under existing law; (3) members of officers of the reserve corps between the ages of 21 and 27; (4) commissioned officers of the National Guard between the ages of 21 and 27; (5) such honor graduates of distinguished colleges between the ages of 21 and 27 as may be entitled to preference by general orders of the War Department; (6) candidates from civil life between the ages of 21 and 27.

The act further provides that appointments to the grade of Second Lieutenant in the Corps of Engineers shall continue to be made as now provided by law. Officers of the Army and Navy, however, may become candidates for appointment as Second Lieutenant of Engineers under the provisions of a law of 1911 without previously vacating their commissions as officers. A further important provision is that the Secretary of War may, in his discretion, allow persons to become candidates for the Second Lieutenancy without previously establishing their eligibility for appointment as a Junior Engineer under the Engineer Bureau of the War Department.

Notwithstanding all that has been said in the past two years concerning the need of an increase in the number of army officers and especially of Engineers, there are fourteen vacancies in the Second Lieutenancies provided for by the old law and two vacancies in the list of First Lieutenancies. The figures in the table show that to comply with the new law there must be for the next five years 51 more appointments to the Corps of Engineers annually than have been made under the present law.

That the method hitherto in force for the examination of candidates for admission to the Corps of Engineers has been such as to prevent the increase in the corps which is authorized by law and which has long been demanded by the conditions of the service, is obvious from the vacancies now existing. It is beyond question, therefore, that a radical alteration in the requirements for admission to the corps must be worked out and put in force in order to comply with the new law.

"The Cohesive Power of Public Plunder"

The River and Harbor Bill, which passed the House on Apr. 11, carrying appropriations of about $40,000,000, was passed by the Senate on May 29, with amendments increasing the total appropriations to nearly $44,000,000. On its final passage the vote was 35 in favor of the bill to 32 opposed, with 29 senators not voting. The narrow margin by which the bill was finally passed indicates the formidable opposition that was encountered in the Senate.

A remarkable feature of the debate was the frank admission by a number of the senators who favored and voted for the bill that many of the items it contained were unjustifiable and a waste of public funds. For example, Senator Clarke of Arkansas, the chairman of

the Senate Committee on Commerce, which prepared and had charge of the Senate bill, said:

> There comes to be a kind of rivalry between boards of trade in local communities to have the same wasteful expenditure of public money made within the particular zone of their influence as takes place elsewhere. In the beginning this manifested itself as a demand upon the individual members of Congress. This system of selection proceeded to a point of demoralization, where the resulting bill was known as a pork-barrel bill.
>
> To protect the treasury against that character of assault, the method of submitting all projects to the scrutiny of a board of engineers was invented and has progressed until the present day. It has eventuated in the approval of projects involving appropriations of the $43,000,000 contained in this bill, plus about $150,000,000 more of approved projects ready to go into some other bill. My experience in the last 12 years has satisfied me that this method has broken down just about as badly as the other and that the time has now arrived when a move forward must be made and other plans of national defense of the treasury supplied. We have reached a place in this river and harbor business, if the thing keeps up at the pace at which it is now going, when there will be a revulsion of sentiment in this country that will stop the whole business.

Closely parallel to this statement by Chairman Clarke were the remarks of Senator Smoot of Utah, who said:

> This bill carries appropriations of over $43,000,000. I state without hesitation that at least 33⅓% of them ought to be eliminated from the bill. I will say frankly that I have given more attention to river and harbor bills during the last three years than in all of my previous service in the Senate. I always felt and feel now that there ought to be liberal appropriations for the improvement of our rivers and harbors, but what I object to is projects in the bill which I believe no one can justly defend. This is the last river and harbor bill made in the form in which this bill is framed that will pass Congress.

Senator Kenyon of Iowa led the fight against the bill and in the concluding speech of the debate said:

> This Senate is about to pass a bill which few senators had the temerity to defend. You are appropriating hundreds of thousands of dollars for streams where Congress has ordered the reëxamination and no report has as yet been filed by the engineers. You are dumping hundreds of thousands of dollars into streams where commerce is constantly growing less and in some cases is practically nothing. You are making appropriations for streams not over 1 ft. in depth. You are appropriating for others where the testimony before the House committee was that you could not tell when you crossed the river. You are appropriating hundreds of thousands of dollars for projects which the army engineers have condemned. You are about to vote from the treasury, in a time of great national stress and strain, at least $20,000,000 in unjustifiable projects. A fight against this method of appropriating public money is going on. I risk the prophecy that this is the last river and harbor bill framed along the lines of the present bill that will ever pass Congress. Some day a Congress will be here that will not consider those the greatest statesmen who get the most out of the national treasury. Some day a Congress will think along national lines and not state and district lines, and that day is coming just as certainly as tomorrow's sun will rise.

The foregoing quotations are typical of the debate that has been going on in the Senate for over a month. There was of course the usual hackneyed defense of water transportation and the usual display of senatorial courtesy in tacit recognition that a senator from a state is bound to defend and work for appropriations for his state, whether they are good or bad. It was clear, however, that at least three-quarters of the senators fully understand the inherent corruption in the present method of making up river and harbor bills and would gladly welcome some method of framing such bills that would place the interests of commerce and navigation first and relieve members of Congress of the present responsibility for drawing all the money they can from the national treasury to be spent among their own constituents.

One of the most interesting features of the debate on the bill was the offer of several amendments looking to some better method of distributing Federal appropriations for the benefit of navigation. Senator Shafroth of Colorado offered an amendment:

> That each of the appropriations contained in this bill shall become available only in the event that states, counties, cities or individuals shall pay into the treasury as part of the same 20% of the amount thereof.

There was hearty approval of the principle embodied in this amendment. It was in fact recommended in the report of the National Waterways Commission some years ago. In the form presented, however, there was general agreement that it would be difficult of application, one reason being that the local benefits from a harbor improvement, for example, may be spread over such an extended territory that it would be impossible justly to assess a contribution on those helped.

Senator Newlands of Nevada offered an amendment incorporating his well-known scheme for a national river-regulation commission to be placed in control of everything in connection with the flow of streams, from irrigation and municipal water-supply to water power and navigation. This amendment was accepted by Chairman Clarke for the committee in charge of the bill, but was later struck out on a point of order. A much more practical scheme was embodied in an amendment offered by Senator Kenyon of Iowa, which provided for the creation of a permanent national waterway commission of five members whose duty it would be to investigate the entire subject of Federal waterway improvements and report to Congress upon the merits of each project. This amendment was also struck out on a point of order.

The same disposition was made of an amendment to create "an inspector of river and harbor work who should be a trained and experienced civil egineer, not connected in any way with the army." This inspector was to examine thoroughly all the river and harbor projects adopted by Congress, ascertain whether the money was being expended with the best economy and efficiency, and also to what extent the needs of commerce justified the expenditure. This inspector was to receive a salary of $7,000 a year and was expected apparently by his individual exertions to make a detailed investigation of each and all the river and harbor projects throughout the length and breadth of the United States. It was quite as well that this amendment failed.

It should be emphasized that the senators who led the fight against the bill almost without exception emphasized, as did Senator Smoot in the quotation already given, their approval of works to aid navigation where the expenditure is justified by the actual benefit to commerce. Very likely a sum as great as the entire appropriation carried by the present bill could be profitably expended in the next fiscal year on work for navigation improvement, provided it were concentrated on meritorious works and not distributed over the country in order to give a due share to each influential congressman.

As Chairman Clarke himself pointed out in the remarks previously quoted, it is only too evident that reliance on the army engineers as a check upon national extravagance and wastefulness in waterway improvement has all but broken down. It is too much to expect that the engineer officer in charge of a district will always be brave enough and strong enough to stand up single-handed and alone and oppose the demand of the commercial organizations in the locality for a big slice of

money from the national treasury. Even if he has the courage to do it, the local organizations and local newspapers may neutralize his efforts.

Colonel Deakyne's report on the Missouri River improvement, when he was stationed at Kansas City, is an excellent illustration. Colonel Deakyne, in the discharge of his duty as an able and conscientious engineer, reported that the proposed expenditure of $20,000,000 by the Federal treasury in an attempt to revive navigation on the Missouri River from Kansas City to its mouth was an unjustifiable expenditure of public funds. It is difficult to see how any competent engineer thoroughly familiar with that river, with transportation conditions in that locality and with the history of river transportation on Western rivers during the last two decades could have made any other report.

The result of this conscientious discharge of his duty, however, was a social and business boycott of Colonel Deakyne, which eventually compelled his transfer to another station. It may be mentioned in passing that a notable feature of the Senate debate was the splendid defense of Colonel Deakyne made by Senator Husting of Wisconsin in connection with one of the ablest arguments ever heard in Congress against the present system of spending Federal funds for the benefit of local land and business interests.

We call attention to the case of Colonel Deakyne, however, because it is not exceptional, but typical. Officers of the Engineer Corps have a high reputation for honesty and ability; but they are after all only men, and it is too much to expect that alone and single-handed they will be able successfully to oppose an overwhelming current of local public sentiment in favor of Federal appropriations for their district. It is not at all strange that the young captains and majors in the corps, in view of the experiences of Colonel Deakyne and others, should feel that it is practically useless for them to oppose their individual opinions against the popular sentiment of the business community in which they live and work.

It is doubtful if any body of engineers would be able successfully to combat the influences that work to secure these appropriations. It is of little avail to prove that an appropriation will be of no real benefit to navigation when the parties who are working for the appropriation do not really care two pins for navigation and are merely desirous of securing the expenditure of money from the Federal treasury to benefit private landowners and other interests.

The most promising plan of reform appears to be through the development of some workable system whereby those who clamor for Federal funds for a river and harbor project will have to pay a material part of the cost themselves.

Coupled with this should be the creation of a permanent national commission, clothed with some such broad powers as those granted the Interstate Commerce Commission, with authority to supervise all Federal works for navigation improvement. Such a commission should be composed of men of such standing with the public that Congress would not dare to override its recommendations as to the distribution of public funds.

Letters to the Editor

"Spouting" or "Chuting"?

Sir—The use of the two words "spouting" and "chuting" as synonymous terms in your abstract of the committee report on spouted concrete, presented at the National Conference on Concrete Roads (*Engineering News*, Apr. 27, 1916, p. 802), suggests that a distinction between these terms is very desirable.

The report deals with the discharge of concrete directly from the mixer into a short chute leading to the form or the surface of the road. This process appears to be well covered by the term "chuting." The term "spouting" is more generally applied to the use of long spouts extending from elevator towers in which the concrete is hoisted by buckets to the head of the spout.

The angle of slope, consistency of concrete and other conditions would be very different for the two methods, and it would be convenient if the distinction of terms could be generally adopted. SPOUTER.

Chicago, June 1, 1916.

[While the distinction noted by our correspondent may be desirable, it can hardly be called common. The processes noted may indeed be quite distinct and should properly be distinguished in nomenclature, but they are both comparatively novel and have not yet achieved an unassailed position in the technical vocabulary. Even the manufacturers of apparatus are not quite clear as to the difference in terms. While the elevating and depositing methods are generally termed "spouting" in their catalogs, the troughs to convey the concrete are variously called "chutes" and "spouts." Furthermore, the average concrete worker uses the words interchangeably.

Which term would our correspondent apply to a system in which a concrete mixer on top of a slope dumps directly into a trough leading to a pier footing 150 ft. below? And would the same term apply to another part of the slope where the footing was only 10 ft. below the mixer but the method the same except for length of trough? The effect in the former case is the same as in the "spouting" system of the foregoing letter; in the latter we have the "chuting" system. At just what depth of cut or length of trough does the change take place?—Editor.]

Co-operation Conference

Sir—Your poignant editorial "Coöperate, but to What End?" in your issue of Apr. 27, should help stimulate engineers to develop a workable plan for federation of effort along lines of common interest. To continue your metaphor of the doctor examining the patient, you have touched a tender spot and the patient winces. It will help reach the correct diagnosis.

The Conference on Coöperation held in Chicago April 13 and 14 accomplished more than is written in the resolutions adopted. These merely took up the work where we left off and made provision for future progress. A careful observer might copy the resolutions triple space and freely interline them, wisely indifferent to criticisms that nothing was done. Some of the interlineations would be after this fashion:

Coöperation has been begun when representatives from St. Louis, St. Paul, Chicago, Philadelphia, Cleveland, Pittsburgh, and from state societies like Illinois, Iowa, North Dakota, Ohio, Kansas, and from other local, state and national societies, meet and exchange ideas, get acquainted and gather inspiration from hearing about each other's successes and failures. It is worthy of note that almost all the delegates were in constant attendance at the sessions and manifested an interest which will not be satisfied until the goal is reached.

An annual conference—congress, council or whatever other name is applied—would be well worth while if it served no other purpose than to furnish a forum for the exchange of ideas on subjects of common interest to all engineers. Let us pause to read Isham Randolph's expression in words of the spirit of the conference:

Let us have a central organization—call it what you will—which has no authority to command, but which has ears to hear and the voice to be heard, and let those ears be open to every plea or promise of common good, and let that voice go out to all affiliated bodies carrying this plea or this promise for the common good, and let us come together at least once a year and feel that "touch of nature which makes the whole world kin," and growing out of that kinship let us consider and do those helpful things which will bless our comrades and overflow with helpfulness to our country and our kind.

In the end all questions, and controversies arising from their discussion, are settled on fundamental principles. The fundamental principle that underlies the get-together movement among engineers is the same as has always led other bodies of men of common interests to band together. Why did the Chambers of Commerce in the various cities form a national body? Or why did the Thirteen Colonies form the United States? It might be well to reflect upon the reason of the near-failure of the Colonies in the Revolution. A re-reading of the history of that period is illuminating.

Someone has aptly characterized the movement toward coöperation among engineers as a ground swell. The desire to work together finds expression everywhere. The call, as you have pointed out, is for leadership which can bring the great mass of engineers into a vigorous, harmonious whole and use the forces thus organized for the benefit of the engineer and the community. Your editorial is an excellent incentive to thought. Thought will lead to action along the lines which, it is hoped, the subcommittee created at the conference will lay down.

C. E. Drayer,
Secretary, Committee on Engineering Coöperation.
Cleveland, Ohio, May 14, 1916.

The Montreal Centrifugal Pump

Sir—Your comments upon the basis of the performance of the centrifugal pump at Montreal are well taken. I think that every effort should be made in such matters to see that pumping engine guarantees are based upon the performance of the main engine unmixed, so to speak, with auxiliaries. The guarantee in this case should have been based upon the use of steam which entered the turbine, and none should have been extracted for auxiliary purposes during the trial. Only in this way are we able to have a measure of the state of the art of centrifugal pump and turbine design and means of comparison with pumping engines of other types.

That salesmen sometimes seek to take advantage of the lack of information of water-works officials in making guarantees of economy is well known. I have in mind such a case in a suburb of Boston, where the guaranteed duty was based upon the steam used less that condensed in the cylinder jackets, as if the jacket steam was not used by the engine as well as that which acted directly upon the pistons.

It has been my custom, and it should always be the custom, to base a performance upon the steam used by the engine itself as a measure of the merits of the engine and means of comparison with other engines. The exhaust steam from auxiliaries can be used for heating feed water, or after the acceptance trial is over it can be used in any way desired. Likewise after the trial, steam from a stage of the turbine can be extracted for saving fuel. At all events, whatever is done, let us have a means of judging of the performance of the pump and prime mover by themselves. F. W. Dean.

53 State St., Boston, Mass., May 26, 1916.

Quality of Bituminous Binder as Affecting Road Wear

Sir—No one with a knowledge of the subject would seriously disagree with the main contentions of Mr. Ripley's article in your issue of May 11 on "Lessons in Road Maintenance From New York State," or with your editorial in the same issue. There is, however, a phase of this subject that calls for supplementary comment. The inference one would naturally draw both from Mr. Ripley's article and from your editorial is that all New York State roads have performed in a substantially similar manner. This is not the case. On the contrary the records and even superficial observation will confirm the statement that a great many of the bituminous roads built in 1914-15 are not now in as good condition, despite the fact that they have cost more for maintenance, as are roads which were built in 1909-10-11.

The writer has before him a list of forty penetration-asphalt roads constructed from 1909 to 1911. Only twelve of these roads have cost anything for maintenance, although it is undoubtedly true that they should have received some attention. Some twenty roads could be mentioned in the same category; namely, that of roads which have carried heavy traffic for five or six years and are now in good condition, although it is undoubtedly true that a carpet coat would be a good investment from the point of view of prolonging the life of the road beyond what may be expected if the surface is not given a superficial application of asphalt and screenings.

The Spring Ave.-Troy road and the Indian Fields-Dormansville road are particularly good examples of the writer's contention that New York has many asphalt roads built five and six and seven years ago that have cost practically nothing for maintenance. Is it not significant that the roads that have given the best service are those that were built with certain materials under certain specifications and under certain supervision, while roads built with other materials at much later dates have, generally speaking, all gone to pieces? These older roads are carrying the identical traffic that has so greatly increased the maintenance on newer roads. Why is it that the

maintenance on the earlier roads is negligible while the maintenance on the newer roads has become so serious a factor?

In the opinion of those who have most carefully investigated the subject with a view to obtaining the truth of the matter for their own commercial enlightenment, New York's 1909-10-11 roads built with a natural asphalt binder by the penetration method have proved that they can economically carry the traffic imposed upon them.

Mr. Ripley mentions as one of the two main causes of deterioration "the reduction in the binding quality of the bituminous material." Of course it cannot be expected that a bituminous road the life of which depends upon the continued cementing power of the asphalt binder, will stand up if bitumens are used, the cementing power of which is quickly lost. New York is finding out that poor binders are a poor investment. The state has ample evidence, however, that good and lasting binders build good and lasting roads. It is not fair that the failures due to poor materials and poor workmanship should be used to cast discredit upon good materials and good workmanship.

DANIEL T. PIERCE,
Barber Asphalt Paving Co.

Land Title Building, Philadelphia, May 23, 1916.

Paving Problems in Texas and Missouri Cities

Sir—In some of your recent issues I have noticed articles about street paving in Texas. In your issue of Apr. 27 you pointed out that the Texas homestead law causes paving contractors to add a charge of about 10c. per sq.yd. to their bidders for pavement. Let us step over in Missouri and see the conditions there.

In Kansas City, special tax bills are issued against the adjoining property and sometimes against what is called the benefit district—frequently over the protest of private property owners, who must pay these bills whether they want the street improved or not. The contractor goes over the streets to be paved and if there is any bad looking property adjoining them, which is very often the case, he adds about 12 or 15% to his bidding price and then, as these bills have a long time to run, and he is not given them until the work is completed, he must find a way to obtain money to carry on the work. He goes to some investment company, which takes his bills at a discount of say 10%, which makes it necessary to add this also to his bid to balance the good ones from the bad ones. He does the work, the investment company allows him the money, and then the company holds these bills for collection, which are drawing 7% interest. If a special tax bill for paving for $100 was levied against a piece of property and the first year the owner paid $50, the second year he would have to pay 7% on the $100, and continue to do so until the entire principal is paid. As the city does not pay for any part of street improvements whatever, I think the cost of paving streets in Texas is about 10% cheaper than the cost of pavement in Missouri.

Bartlett, Tex., a town of about 4,000 people, recently let a contract for paving its streets—27,200 sq.yd. at $2.05 per sq.yd. This is to be 3-in. vertical fiber brick laid on a 1½-in. sand cushion with a 5-in. concrete base and with cement filler. I have seen 6-in. concrete pavement let in Kansas City, Mo., for $1.48 per sq.yd., which is indeed high for 6-in. concrete pavement. If Kansas City would pay the contractor cash and give him monthly estimates, I am sure that the cost of pavement would be reduced about 15% at least.

Do not let us be too hard with Texas, as she is just now waking up to the fact that she needs good streets and roads, as is shown by the example the little town Bartlett has set.

GEORGE CHARTRAND.

State Bank Building, Kansas City, Mo., May 12, 1916.

More on Flood Diversion Ditch Washout at Sioux Falls

Sir—In your issue of May 18, p. 965, there is an item about a washout on a concrete-lined ditch, at Sioux Falls, S. D. I send you herewith a photograph wherein you can see that a hole has been washed out about 350 ft. long and about the same width, and where the water comes down is a fall of about 40 ft.

From the highway bridge over the ditch, in the rear of the view, to the river in the foreground is about 1,000

DITCH WASHOUT DIGS DEEP HOLE NEAR SIOUX FALLS

ft. and the drop is 101 ft. About one-half of the water falling comes out from underneath the concrete trough of the ditch. I do not know who is to blame for the design, but if proper precaution had been taken to keep the water from getting under the concrete, the washout would not have occurred.

ADOLPH YAPPEN.

Grand and N. California Ave., Chicago Ill.,
May 22, 1916.

Publication of Los Angeles Aqueduct Report

Sir—The Los Angeles Board of Public Service Commissioners has nearly ready for the press the "Final Report of the Construction of the Los Angeles Aqueduct," which has been in preparation over a year. Practically all the phases of the great work are taken up and painstakingly set forth in all necessary detail. Following a history of the enterprise, and an engineering description of the project as a whole, the report includes chapters on hauling, municipal tufa cement manufacture, building dams by the sluicing method, excavation, construction of concrete conduits, tunnel boring, the theory and practice of the bonus system as applied to municipal work, the fabrication of the steel siphons 7 to 11 ft. in diameter and concrete

pipe of 10 ft. in diameter, cost keeping and accounting, sanitary aspects of the water supply, etc.

Throughout the volume are tables of costs of the various classes of work, as well as running comments on mistakes made, difficulties overcome or shortcuts taken.

The volume will be 8½x11 in. in size, of about 350 pages, in stout library binding and illustrated by 62 full-page and 24 half-page halftones and 34 line cuts of engineering designs.

The Board of Public Service Commissioners realizes that this report on a great engineering work will be desired by engineers and engineering reference libraries in all parts of the United States and abroad and desires to make it available to them. The cost of publication, however, forbids free distribution and the Board has therefore decided to fix a moderate price on the volume, less than the actual cost of printing and postage. This price is $1.95, delivered.

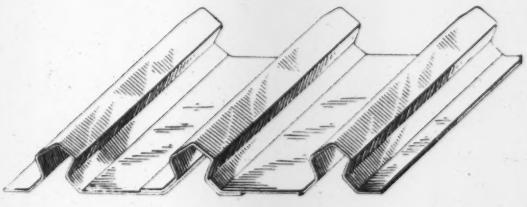
The Board is not in the publishing business, derives no profit from the sale of the volume and has no interest in its distribution other than the desire to make the record of the great work done for the City of Los Angeles available to engineers who desire it. Only the number of copies will be ordered printed for which orders have been received at the time of going to press, plus the number the Board may require. Orders must therefore be made immediately to insure acceptance. Checks should be made payable to the Los Angeles Department of Public Service, 645 South Olive St.

R. F. DEL VALLE,
President, Department of Public Service.

Los Angeles, Calif., May 22, 1916.

Integral Steel Plate To Make Concrete Tank Water-Tight

Sir—In recent years there have been numerous discussions and descriptions of circular reinforced-concrete storage tanks that seem to leak more or less. The writer does not believe that this condition is serious from the standpoint of a complete collapse; but if these leaks are allowed to continue from year to year, it will be found that the tank will soon be beyond repairs, and it would prove to be serious, especially if a town or city is dependent upon the water-supply from such a tank or standpipe. The vital point in question is how to make such a tank water-tight, for in the writer's opinion it can be safely said that under the accepted methods of design and construction a reinforced-concrete tank of a size larger than can be built in one operation cannot be made water-tight without an elastic membrane forming a water-tight seal throughout. This membrane should be protected by a concrete, brick or plaster lining, as it otherwise will be injured by ice that may freeze on the inside.



TYPE OF STEEL PLATE SUGGESTED AS FORM AND REINFORCEMENT IN REINFORCED-CONCRETE TANKS

Accordingly, the writer has decided that in future constructions of this type he will adopt an innovation in design. The patented steel plates shown in the accompanying view are used in construction for many purposes, such as forms, walls, roofs, partitions, floors, etc. By using them as forms and vertical reinforcement it will be seen that the interior of a tank would have one continuous sheet of metal, as the plates are solid and not perforated. The circumferential steel reinforcement (which should be round rods) is placed in the forms, fastened and hung from the outside plate of the tank by means of wire brackets, which would eliminate the expensive operation of wiring the steel together and holding it in place. Care should be taken to leave all field joints in the concrete in the middle of the plates—the point of greatest strength.

After the plates, steel and concrete are placed and the bracing removed, the interior and exterior surfaces of the plates could be coated with 1 in. or more of gunite (cement mortar applied with the cement gun). The exterior could be left with any desired finish. If the top of the tank is to be covered, the plates can be used for forms as well as reinforcement in connection with the steel-frame or concrete-beam construction which goes to make up the roof.

The writer feels justified in stating that anyone would be safe in guaranteeing such a structure to be water-tight and permanent.

N. F. AMBURSEN.

12 West St., Boston, Mass., Apr. 22, 1916.

NOTES AND QUERIES

Bridge Reconstruction on the Fort Dodge, Des Moines & Southern Ry. was described in "Engineering News," May 25, 1916, and the contractor was the Ferro Construction Co., of Chicago, not Farrell Construction Co., as stated.

Pirahy Tunnel, Brazil—By a typographical error in the article "Rapid Tunneling in Brazil," by J. C. Balcomb, "Engineering News," May 18, p. 925, the maximum miss in levels was stated in one place to be 0.181 ft. instead of the correct figure 0.081 ft. The latter was given correctly in the accompanying table. Use of a comma instead of a period to mark the decimals in this table made the tunnel 27,657,174 ft. long instead of 27,657.174.

Road Maintenance in New York—Attention has been called to an important stenographic error in the article "Lessons in Road Maintenance from New York State," by T. M. Ripley, in "Engineering News," May 11. By the substitution of the word "maintenance" for "bituminous" in the fifth line, third paragraph, p. 887, the meaning has been distorted. This paragraph should read:

> The construction of a bituminous top required entirely different treatment than did the waterbound top, and engineers and contractors were both ignorant as to the methods required. It took several years to learn the most essential points in the construction of a bituminous top, in order that the road might be smooth when completed—and even today this desirable condition is not always obtained.

An Argument for Licensing Engineers—D. E. C. reports the recent remarks of a young engineer on the subject of licensing engineers, substantially as follows: The young engineer remarked that just as he was well started in college he had to quit. Since then he has studied until he feels that he now knows as much as a graduate engineer. Yet he is ever up against the prejudice in favor of the graduate. He wants a license which will show that as a result of public examination he has the same general kind of knowledge as he would have acquired had he continued in college and as would have been attested more or less directly by his diploma. Such a certificate, he thinks, would establish his status as an engineer. Our correspondent remarks, after paraphrasing the young engineer's conversation as given above: "To me it is noticeable that the young men are in favor of regulation. The future will reflect this."

Dominion Reports 418,500 Hp. on Winnipeg River

The report of the Dominion Water-Power Branch, Ottawa, Canada, just printed (as Water Resources Paper No. 3), shows a possible development of 418,500 hp. continuous 24-hr. power on the Winnipeg River between Lake-of-the-Woods and Lake Winnipeg in Manitoba. This stream is at the borders of the fuelless prairies of the province, the center of gravity of power being only 62 mi. from the City of Winnipeg.

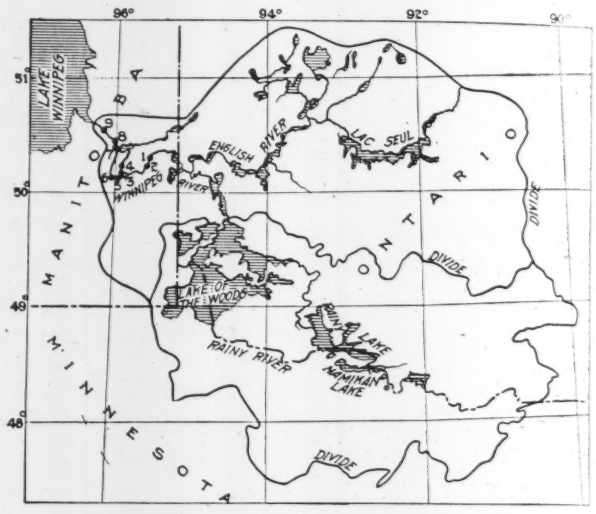
So many applications were filed for development of the several rights that a reserve was placed on all the undeveloped sites until the whole river could be studied by the Dominion. For this survey, the advice of J. R. Freeman, of Providence, R. I., and J. B. McRae, of Ottawa, was secured, and a preliminary reconnaissance was made in 1911 by them in company with J. T. Johnston, now Chief Hydraulic Engineer of the Water-Power Branch (author of the report). On their advice, a complete contour survey of the river was made, with cross-sections and soundings at all falls and rapids. Seven sites have been selected, at which practically all the undeveloped fall of the river can be utilized, and detailed designs have been prepared for determining the engineering and commercial features and costs. The unregulated minimum flow has been found to be 12,000 sec.-ft. for those plants, but the storage afforded by the Lake-of-the-Woods and auxiliary reservoirs may raise this to 20,000 sec.-ft.

Existing Developments

The Winnipeg River in Manitoba does not adapt itself to small developments. The first large plant built was that of the Winnipeg Electric Railway Co. on the Pinawa Channel, built in 1902 to 1906. There are three diversion weirs across the main and secondary channels, each of them governed by a control dam. The head is 39 ft. and there are four 1,000-kw. and five 2,000-kw. generating units; 8,000 sec.-ft. is the necessary flow down this channel.

In 1911 the City of Winnipeg's municipal station at Point du Bois was put in operation. A concrete gravity-section dam was thrown across a narrow part of the main channel and a forebay channel cut across an adjacent point. The head is 45 ft. and the present installation comprises five 3,000-kw. and three 5,000-kv.-a. units. There is space for eight more units and a flow of 24,000 sec.-ft. will ultimately be required.

There are a few plants on the Winnipeg River in Ontario to be noted in any discussion of the Winnipeg River, although the Dominion Water-Power Branch has no jurisdiction in the Eastern provinces. In 1898 the town of Kenora built a municipal station on the eastern outlet of Lake-of-the-Woods where there was an abrupt drop of 20 ft. from lake to river. This now has four 625-kw. generators in a power house which is combined with a dam. In Keewatin, near Kenora, the Lake-of-the-Woods Milling Co. uses some 4,000 hp. There is a



DRAINAGE AREA OF WINNIPEG RIVER

1—Winnipeg Municipal Plant; 2—Slave Falls Site; 3—Upper Pinawa Site; 4—Winnipeg Electric Railway Plant; 5—Upper Seven Sisters Site; 6—Lower Seven Sisters Site; 7—McArthur Falls Site; 8—Du Bonnet Site; 9—Pine Falls Site.

15,000-hp. development of the Minnesota & Ontario Power Co. on the Canadian side of the Rainy River at Fort Francis.

About 15 mi. below Kenora are White Dog Rapids where a 45-ft. drop makes possible the development of 75,000 hp. On the English River coming down on the north from the Lac Seul region are several sites where from 20,000 to 40,000 hp. each could be developed.

In the district studied, the Laurentian granite lies practically on the surface and the river consists of a series of broad basins with abrupt changes in level occasioned by granite outcrops forming distinct ridges of elevation higher than the pond bed above. As a result the gradient between falls is negligible and concentration is possible at a few sites, making use of practically the

CONCENTRATION OF POWER ON WINNIPEG RIVER IN MANITOBA

Natural Conditions		Proposed Developments										
					24-Hr. Power						Estimated Costs	
Falls	Head, Ft.	Falls	Head, Ft.	Miles from Winnipeg	12,000 Sec.-Ft.	20,000 Sec.-Ft.	Turbine 12,000 Sec.-Ft.	Installation 20,000 Sec.-Ft.	Local Pondage, Acres	Local Flooding, Acres	Construction	Per kw.-hr., 100% L. F., Cent.
Pine	9											
Masqua	5	Pine	37	64	37,900	63,100	6–10,000	10–10,000	3,642	375	$4,407,000	$0.108
Silver	21											
Whitemud	12											
Little du Bonnet	8	Du Bonnet	56	64	57,300	45,500	12–10,000	14–10,000	1,700	360	6,551,000	0.102
Grand du Bonnet	35											
Second McArthur	6	McArthur	18	62	18,400	30,700	11– 2,500	17– 2,500	38 sq.mi.	...	2,740,000	0.136
First McArthur	6											
Lower Seven Sisters	16											
Fourth Seven Sisters	8	Lower Seven Sisters	37	52	12,600	37,900	.....	6–10,000	9,545	70	3,409,000	0.132
Third Seven Sisters	8											
Second Seven Sisters	9											
First Seven Sisters	10	Upper Seven Sisters	29	55	9,900	29,600	.....	8– 6,000	8,470	...	2,724,000	0.138
Diversion Weir	11											
Slave	19	Slave	26	74	26,600	44,400	8– 5,000	13– 5,000	1,300	100	2,327,000	0.117
Eight Foot	7											
Point du Bois	31	Winnipeg			21,100	51,800	.....	.....	....	...	.....	.....
Lamprey	16	Municipal	45	76	additional	additional						
Upper Pinawa Channel	..	Upper Pinawa	18	58	...	12,300	.....	4– 4,500	9,250	425	1,280,000	0.159
Developed to date	..	.....	..	..	53,200	53,200	.....	.....	....	...	.....	.....

entire fall. The accompanying table shows the present conditions and proposed modifications.

The whole basin, shown in the accompanying map, is dotted with lakes of greater or smaller size, the most important ones for the control of the Winnipeg River being Lake-of-the-Woods, Namikan and Rainy, and for English River, Lac Seul, Minnitaki and Sturgeon; 111 of the lakes have been large enough to investigate as natural storage basins. A minimum flow of 12,000 sec.-ft. in Winnipeg River has been established and regulation to 20,000 sec.-ft. is assured. The drainage area above Lake-of-the-Woods, the key to this regulation of the river, is 26,100 sq.in. This and Rainy Lake will have to store 181 billion cubic feet, giving a draw-down in level of 5 ft., the low level being reached, however, only in extremely dry years. Lac Seul can be relied on for 6,000 sec.-ft. and 10,000 by full practical control; 4,000 sec.-ft. will be necessary to make up the desired 20,000 in Winnipeg River.

The Water-Power Branch urges that the Government must build and operate the storage-control works. Central control should be exercised by joint action of the Branch and the Hydro-Electric Power Commission of Ontario. There would be an engineer in sole and direct charge of the regulation of the whole runoff.

Water-Power Administration in Prairie Provinces

The water powers of the Canadian provinces of Manitoba, Saskatchewan, Alberta, the Northwest Territories and the Yukon are under control of the Dominion Government and are administered by the Water-Power Branch of the Department of the Interior. The announced policy of the branch is to "encourage desirable development of water resources, but to discourage uneconomic and wasteful projects, to insure providing at each site for future development of maximum available power, to insure that units on a river system have a place in a comprehensive plan, to secure adequate storage works in the benefit of all affected developments, to prevent unnecessary duplicate expenditures on the part of competing interests, to protect the consuming and investing public against ill-advised schemes and unsafe structures and to prevent evils of monopolistic control of water resources through Government supervision and by periodical revision of rates," etc.

Complete regulations govern the grant of water powers to private parties; detailed data and designs have to be submitted with each application, and mere priority of application does not carry any rights. In making a grant the Minister of the Interior fixes the time within which works must be begun, the minimum annual expenditure and the amount of water power to be developed within 5 years. The right to use water extends for 21 years, and the lease of Dominion lands necessary in the development of power runs for the same term. In the absence of public lands the minister fixes the limits where the applicant may exercise rights of appropriation. The licenses are renewable for three consecutive terms of 21 years each, and in case a plant is taken by the Dominion the owner is paid for the value of tangible works and land held in fee. No value is allowed for the rights granted or for any profits arising therefrom. The value of land and works is to be fixed by three arbitrators in case of seizure.

Where a licensee does not develop the full capacity of a site and the Government finds more power required by the public demand, it may offer a supplementary license for the added rights to the licensee. If he does not accept it and complete the works, or if the present works would be a hindrance in developing a larger amount of power, or if the granted irrigation rights have prevented advantageous operation, then to the value of the seized works is added a bonus—30% for works in operation less than 5 years, 25% for 5 to 10 years, 20% for works in operation 10 to 15 years, 15% for 15 to 20 years and 10% for over 20 years' operation.

Where the possibilities of a given stream have been thoroughly investigated by the Water-Power Branch and a scheme of development is dictated for the whole river, all water-right grants are for works to be built in general accordance with the announced systems.

Silicon Steel for Bridges

A special feature of the new Ohio River bridge at Metropolis, Ill. (for the Chicago, Burlington & Quincy R.R. and Nashville, Chattanooga & St. Louis R.R.) is the extensive use of silicon steel in the trusses. In steel with 0.30 to 0.35% carbon, the silicon averages from 0.30 to 0.40%. This metal is used for the top chords, main posts, main diagonals, and end panels of the bottom chords. All other rolled structural material is of medium steel. The eyebars and pins are of nickel steel. The accompanying table gives the main characteristics of the steel, as shown by tests on actual specimens.

The effect of the silicon in the steel is to give a higher yield point and ultimate strength, without sacrificing the reduction of area or the elongation in specimen tests. In other words, an increase in strength is obtained without the metal becoming hard and brittle.

The same grades of steel are to be used in the new bridge of the Chicago, Burlington & Quincy R.R. at Kansas City, Mo. C. H. Cartlidge, Bridge Engineer of this railway, is engineer for both the bridges mentioned. The steel is being supplied by the American Bridge Co.

TESTS OF SILICON STEEL AND OTHER STEEL FOR THE OHIO RIVER BRIDGE AT METROPOLIS, ILL.

Grade of Steel	Piece	Size, In.	Length, In.	Elastic Limit, Lb. per Sq.In.	Ultimate Strength, Lb. per Sq.In.	Elongation in 8 in., Per Cent.	Reduction of Area, Per Cent.	Fracture	Carbon, Per Cent.	Manganese, Per Cent.	Phosphorus, Per Cent.	Sulphur, Per Cent.	Silicon, Per Cent.	Nickel, Per Cent.
Silicon steel....	Plate	42x1¾	435½	53,870	86,000	18.5	30.8	½ cup	0.34	0.74	0.016	0.036	0.320	....
Silicon steel....	Plate	42x1¾	435½	50,160	81,350	19.7	37.1	½ cup	0.31	0.68	0.016	0.031	0.350	....
Silicon steel....	Plate	42x1¾	608	47,450	86,780	18.5	40.2	½ cup	0.29	0.70	0.020	0.037	0.400	....
Silicon steel....	Plate	42x1¾	703	49,660	83,640	19.7	43.7	Angular	0.30	0.65	0.016	0.034	0.350	....
Silicon steel....	Angle	8x8x1¼	608	51,400	89,280	19.7	41.9	Silky, ½ cup	0.32	0.52	0.023	0.030	0.300	....
Silicon steel....	Angle	8x8x1¼	595	48,000	82,640	16.6	31.7	.....	0.35	0.57	0.024	0.040	0.274	....
Silicon steel....	Angle	8x8x1¼	690	50,720	84,220	19.2	46.3	Silky, Ang.	0.35	0.52	0.029	0.040	0.300	....
Medium steel....	Plate	33x ¾	348	38,620	63,400	27.5	57.4	Cup	0.22	0.35	0.014	0.028	.....	....
Medium steel....	Plate	21x1¼	110	38,000	62,390	26.7	52.0	½ cup	0.25	0.54	0.014	0.047	.....	....
Medium steel....	Angle	8x8x ¾	390	38,100	60,600	28.5	54.0	Cup	0.20	0.59	0.020	0.026	.....	....
Nickel steel*....	Eyebar	12x1¾	436	57,000	92,640	13.1 (in 18 ft.)	40.2	100%, silky cup	0.34	0.60	0.016	0.026	0.060	3.27

* Note. Full size test of nickel-steel eyebar; elongation in 18 ft.

Plattsburg Dam Goes Out

SYNOPSIS—Six bays of hollow reinforced-concrete dam on glacial drift fail, after continued leakage through foundation. City authorities had made no effort to control leakage since early trench cutoff had been temporarily effective.

The hollow reinforced-concrete dam of the City of Plattsburg, N. Y., at West Brook Reservoir No. 3 failed at about 9 a.m. on May 15. This apparently was due to the destruction of foundations under Bays 3 to 7 after several weeks' leakage. Six of the 22 bays, or 90 ft. of length, were torn out and pieces washed a mile downstream.

As shown in Fig. 1, and as described in detail in *Engineering News*, Jan. 20, 1916, this was a 22-bay structure completed early in 1915 and creating a water-supply reservoir in glacial drift. There had been some trouble in making the reservoir tight from the first (although the reservoir was filled in the spring of 1915) and a trench 6 ft. to 22 ft. deep, 3 ft. wide at the bottom and 5 ft. across the top in front of the upstream toe had been filled with puddled clay. No leaks then showed under 14 ft. of water—all the test then possible. When the reservoir was filled, early in March of this year, there was little or no leakage, but as frost came out of the ground a little weepage was noted in Bay 8, a slight flow from the holes in Bay 4 and some traces in the bays to the east. The weep holes in Bay 8 are reported to have been plugged by some city official a few weeks before the break.

It is reported that there was no person in charge of this dam and that no systematic watch or measurement of the leakage had been kept since Jan. 1, 1916, when the city administration that built the dam went out of office. The new mayor and public-works board decided that a city engineer was expensive and unnecessary, such engineering work as was done being paid for on a per diem basis. If anyone assumed responsibility for the structure, the fact is not now known.

On account of this condition of affairs no one knows just what happened at the time of failure. An examination of the site shows that the serious underflow may have developed first under Bays 3 or 4 and then by scour under 5 and 6 as the level dropped. Apparently there was flow first from a point in front of, and 40 ft. or more above, Bay 3. Fig. 3 shows a crater-like depression extending from in front of No. 1 buttress along the 900 ft. level for about 75 ft. upstream and coming back to the dam in front of Buttress 5. This area covers what was the west slope upstream. About 10 ft. below the top an 18-in. sand seam is to be seen, and above this are the typical fine-silt strata described in *Engineering News*, Jan. 20, 1916. Considerable material has fallen from the west bank, which seems to have been left more or less vertical at first.

There is a second hole extending in a semicircle, 25 ft. in diameter, from the toe of Buttress 5 to Buttress 8. This is 10 to 15 ft. deep and extends downstream to the heel of the dam. The cutoff wall is still in the west bank at the top, and the clay fill placed in 1915 largely remains in place along the toe from Buttresses 8 to 18. Just below the dam in the brook bed is a deposit of gravel and sand 8 ft. deep, 30 ft. wide and 200 ft. long.

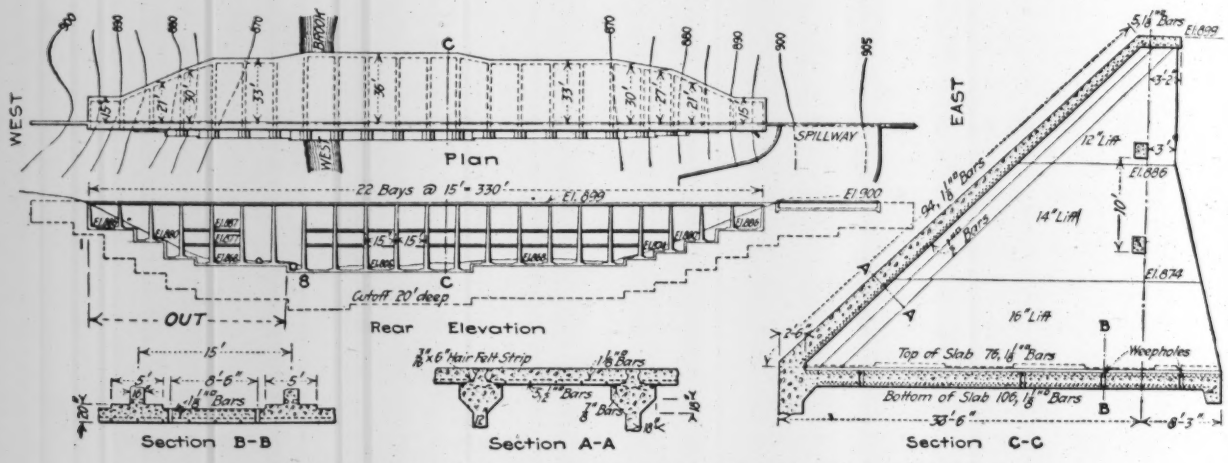


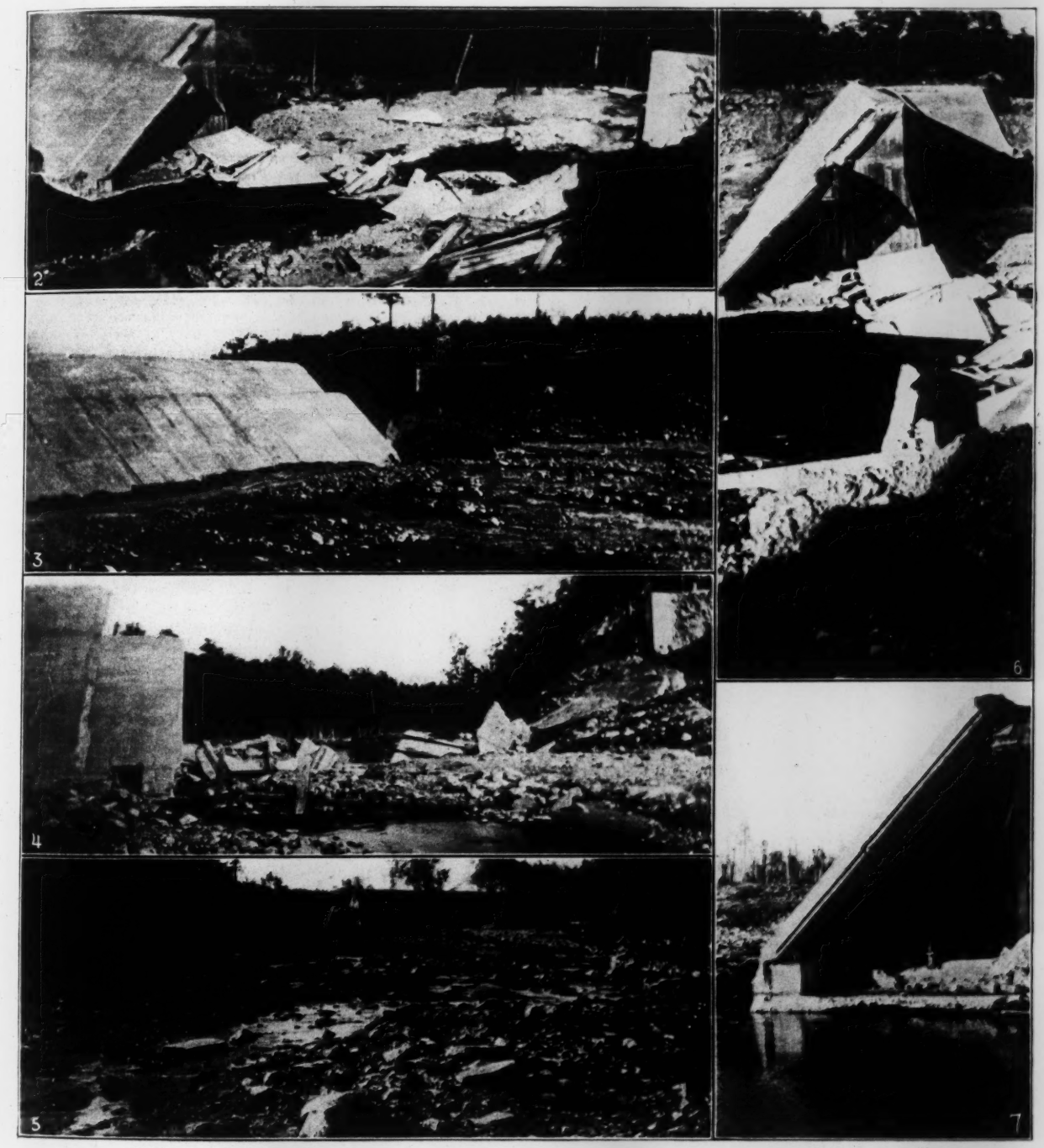
FIG. 1. REINFORCED-CONCRETE DAM AT RESERVOIR NO. 3, PLATTSBURG, N. Y.
Reprinted from "Engineering News," Jan. 20, 1916

The deck appears to have given way while there was still considerable water in the reservoir (the storage capacity was 72 million gallons) for the water rose some 10 ft. above the brook bed and cut a path 50 to 80 ft. wide along the thickly wooded banks for the 2 mi. down to Reservoir No. 2. The brook bed now looks like a small river in dry season. Two small timber bridges a mile below the dam were carried away.

A large amount of silt and vegetation was carried into Reservoir No. 2. The caretaker here by hard work got the flashboards off the spillways of this and No. 1 dam. Both these structures are of earth with concrete core walls; there was little damage beyond some wash on the downstream slope of No. 2. The flood swept safely over No. 1 and into the Saranac River without further damage.

Primary responsibility appears to rest on the existing city officials for what is reported to be an absolute neglect of a dam known to be leaking, and for plugging the lowest-level weepholes. But some measure of responsibility may rest on the previous administration for proceeding in such a delicate task as building a reservoir in glacial drift without the best of engineering advice from start to finish. They retained a consulting engineer for a short period but did not accept advice as to the disadvantages of the site they had selected, nor as to the necessity of employing a contractor and inspector especially experienced in dam building.

The illustrations, showing the collapse of the failed section, are similar to the views of the Stony River dam, West Virginia, which failed in January, 1911 (see *Engineering News*, Jan. 22, 1911, p. 212)



FIGS. 2 TO 7. VIEWS OF THE PLATTSBURG DAM AFTER FAILURE

2—Upstream side of break from west bank, showing 15-ft. hole along standing portion and 6-ft. bank of material carried from west bank under floor; 3—Upstream side of break from east, showing crater in west bank; 4—Stream bed at break, from upstream; 5—From 500 ft. below dam, showing path made by water; condition existing for one mile below, previously thickly wooded; 6—Looking east, cutoff wall in bank at right; 7—Close view of Bay 7, showing deck slab still up and waste pipe intact.

News of the Engineering World

Chicago Drainage-Canal Supply May be Limited by Law

An amendment to the River and Harbor Appropriation Bill adopted by the Senate just before its final passage of that act limits to 250,000 cu.ft. per min. the amount of water that may be drawn from Lake Michigan by the Chicago drainage canals. The amendment was offered by Senator La Follette of Wisconsin, representing the lake interests that have long protested against the heavy draft of water through the drainage canals because of its effect upon the levels of the Great Lakes. In presenting the amendment Senator La Follette read a report by Gen. W. M. Black, Chief of Engineers, dated May 13, 1916, in which the controversy over the flow through the Chicago drainage canal was reviewed.

As engineers who are familiar with the history of the Chicago drainage canal are aware, that work was built without any authority from Congress or any other department of the Federal Government to divert water from the lakes, and Congress has never given official sanction to it. On the completion of the canal in 1899 a conditional permit was granted by the Secretary of War limiting the flow in the canal to 5,000 cu.ft. per sec. On complaint of the navigation interests this order was modified on Dec. 5, 1901, limiting the diversion to 4,167 cu.ft. per sec., or 250,000 cu.ft. per min., and this is now the legal limit. Repeated applications from the sanitary-district authorities to increase the amount of this flow have been refused. In 1907 application to draw an additional 4,000 cu.ft. per sec. through the Calumet River was denied by the department. Evidence of intention to make such diversion, notwithstanding the department's refusal, led to suits for injunction by the Attorney General of the United States, filed in March, 1908, and in October, 1913. These cases are awaiting decision in the United States District Court for the northern district of Illinois.

Notwithstanding the legal limitation, the average daily flow through the Chicago River into the drainage canal has been in excess of 7,000 cu.ft. per sec. since 1910, and measurements by the United States Lake Survey indicate a flow in excess of 8,000 cu.ft. per sec. By way of comparison, General Black stated that this flow is about equal to the low-water flow of the Mississippi River at St. Paul and about half as great as the low-water flow of the Mississippi at Keokuk. General Black stated that the continuous withdrawal of this volume of water will result in the permanent lowering of the surface of Lakes Michigan and Huron by 5 in. or more and of Lake Erie by nearly the same amount. The still greater diversion of 10,000 cu.ft. per sec. or more contemplated by the Illinois authorities will lower Lakes Michigan and Huron by 6.9 in.; Lake Erie by 5.4 in.; and Lake Ontario, 4.5 in. These figures relate to mean lake level. A much greater lowering will occur at low water.

Senator La Follette also presented a letter from the Secretary of the Milwaukee Merchants and Manufacturers Association dated May 26, 1916, stating that the lake-level records kept by the Government engineers show that the levels of the lakes have already been reduced from 6 to 10 in., involving a loss of millions of dollars to the navigation interests. The letter summarized the position of the lake shipping interests as follows:

> The disposal of sewage at Chicago can well be effected with the original grant of water—namely, 250,000 cu.ft. per min. The excess illegally taken—350,000 cu.ft. per min.—is used to create water power at Lockport, Ill. The Illinois ship-canal project, under which the state proposes to expend $5,000,000 on the improvement of the Illinois River and connecting channels to Chicago, is fostered more largely for the purpose of insuring the continued illegal diversion of water, or rather to secure a legal sanction of the same, than to provide a commercial utility. In other words, the real purpose behind the cry of sanitation and ship canals is the continued steal of a colossal flow of lake waters for power purposes. We therefore enter a most earnest protest against any action by the Secretary of War or on the part of Congress that will sanction or legalize the present unwarranted diversion of lake waters into the Chicago drainage canal.

The bill must go to conference, be agreed upon by both houses and signed by the President before becoming law.

Steel and Wood Water Mains at Butte, Mont.

The water mains at Butte, Mont., are under specially trying conditions, owing to the facts that the ground beneath the city is honeycombed with mine drifts and tunnels and that frequent disturbance and settlement occur. For these reasons the Butte Water Co. uses steel pipe, as settlement of the surface does not cause the pipe to break, and leaky joints give notice before the leak becomes serious. The officials consider that with cast-iron pipe such settlement might cause serious breaks and result in great damage.

The use of the steel pipe has been attended with great success, and some of it has been in the ground in service since 1886. The original cost, cost of laying and cost of repairs are said to be much less than for cast-iron pipe. The life of the steel pipe is less than that of cast-iron pipe. The damage from electrolytic action also is believed to be much greater than with the latter, although this is simply a theory based upon the fact that the pipe is much thinner and the electrolytic action would naturally be faster.

The steel pipe is made by the National Tube Co. and has National coating and the Matheson joint, which has proved very successful and has replaced the Converse joint formerly used. It is found to take less lead, to require less skill in setting it up, and to keep tight if ordinary care is taken. During the past three years there has been laid about 5 mi. of 20- and 24-in. steel pipe with these joints, and there was only one leaky joint on the extension. While this record is a good one, it is due partly to the system of having every joint carefully inspected by an expert calker before it is covered.

For the influent pipe lines, continuous-stave pipe with steel bands has given great satisfaction. In 1892 about 9 mi. of 24-in. redwood pipe was built, and a careful

inspection of this line in 1914 showed it to be in excellent condition. The cost of maintenance has been negligible. Since 1892 over 40 mi. of continuous-stave pipe of 24- and 26-in. diameter has been laid and has proved entirely successful.

From the experience with wood pipe a rule has been adopted of never putting the pipe under a static head of less than 50 ft., as the only disintegration discovered in these pipe lines is where the pipe is set very close to the hydraulic grade and the pressure is not sufficient to keep the wood thoroughly saturated.

The foregoing information has been furnished by Eugene Carroll, Vice-President and Manager of the Butte Water Co.

Federal Government Will Build a Nitrate Plant

The Army Reorganization Bill as finally enacted authorizes the President to make an investigation to determine the best process "for the production of nitrates and other products for munitions of war and useful in the manufacture of fertilizers and other useful products." He is further authorized to select a water-power site or other site and to construct a plant for the manufacture of such product. The products of the plant are to be used for military and naval purposes to such extent as the President may deem necessary, and any surplus may be sold under such regulations as he may prescribe. The bill does not specify the capacity of the plant, but $20,000,000 is appropriated for its construction and an issue of Panama Canal bonds to raise the money is authorized in case sufficient funds in the treasury are not available. A provision is inserted that the plant must be operated "solely by the government and not in conjunction with any other industry or enterprise carried on by private capital."

In view of the widely published fact that one of the most needed measures for national defense is the provision of a supply of nitrates which will be available for use at any time the shipment of nitrates from Chili is interrupted, there is no doubt that the government will proceed promptly with the construction of the plant.

Starting Philadelphia's Huge Sewage-Works Project

The initial part of the great sewage-disposal project which the City of Philadelphia has in hand is made possible by the $3,200,000 of bonds just authorized by popular vote, together with a fund of $500,000 already available. The disposition of the two sums is thus outlined in a letter to *Engineering News* from Chester E. Albright, Chief Engineer and Surveyor, Bureau of Surveys, Department of Public Works of Philadelphia:

With the $3,700,000 it is expected that land will be purchased for the sites of the southwest and northeast sewage-treatment works, that the Frankford Creek high-level intercepting sewer will be constructed, that the Frankford low-level intercepting sewers will be constructed with a connection to the upper Delaware intercepting sewer, that a pumping station for the low-level sewage will be built at the Northeast works, and that works for the treatment of the sewage collected by the Frankford Creek intercepting sewers will be constructed at the northeast site.

This is in practical conformity to the report of the Bureau issued in 1915.

Already a little less than a mile of 8½-ft. sewer is under contract, and it is expected that the rest of the Frankford Creek high-level intercepting sewer will be placed under contract very shortly. Surveys are being made and contract drawings will be prepared for the low-level sewers as rapidly as possible, and we look forward to the restoration of Frankford Creek to a clean condition within the next few years.

An abstract of the recommendations made in a report on sewage disposal for Philadelphia by George S. Webster, then Chief of the Bureau of Surveys, George E. Datesman and W. L. Stevenson appeared in *Engineering News* May 27, 1915, page 1051.

A Commission on Waterways and Public Lands will be appointed by Governor McCall, of Massachusetts to succeed the Directors of the Port of Boston and also the Massachusetts Harbor and Land Commission, both of which have been abolished by recent legislative action.

Chicago Voted $3,750,000 on June 5 for extending its municipal street-lighting system. There will be a generating station at the municipal garbage incinerator and three distributed substations. The new equipment is to include 5,800 arc lamps and 25,400 incandescent units.

Illumination of the Statue of Liberty in New York Harbor is provided for by a Senate amendment to the River and Harbor Bill. By this amendment the government is authorized to accept a fund of $30,000, to be raised by popular subscription by the "New York World," for the construction of a plant for illuminating the statue. The government is to maintain and operate the plant after its completion.

The Elimination of Noise from New York City transit lines is to be investigated by a committee made up of Public Service Commissioners Wm. Hayward and Travis H. Whitney and Clifton W. Wilder, electrical engineer of the commission. The committee is to investigate the causes of noise in surface, elevated, and subway cars and trains, and recommend any changes in structure, equipment, and methods of operation which may tend to decrease noise.

Bonds for a New Water-Supply for Oklahoma City, Okla., to the amount of $1,500,000 were authorized on May 20 by a vote of 3,452 to 1,596. The proceeds will be used to develop surface supply by storage on the North Canadian River. At the same election $200,000 were voted for sewerage improvements. Three or four months of preliminary work will be necessary before the water-supply project can be put under construction. Guy V. McClure is City Engineer of Oklahoma City.

The Refuse Destructor at Atlanta, Ga., over the acceptance of which there has been a protracted controversy, apparently due largely if not wholly to a change in administration just after the contracts were signed, was taken over and put in operation by the city on May 14, in accordance with the court decree issued the previous day. The court awarded The Destructor Co., New York City, its claims in full, and directed that the costs of the suit should be divided equally between the city and the company. The destructor is of the Heenan type.

A State Highway Commission for Georgia is provided for in a bill to be introduced in the legislature when it meets this month. The bill provides for three "commissioners-at-large," one of whom shall be the Dean of the Engineering of the University of Georgia, and also for a State Highway Engineer at a salary of $6,000 a year. The commission would collect the motor tax, and the Penitentiary Board would turn over to it 15% of the convicts of the State. Opposition to the latter provision is being made by the Georgia Society of Wardens, Superintendents and County Commissioners, which has prepared a bill designed to leave the control of convicts in the hands of the counties.

The Alaska Coal Fields were opened on June 2 to lease by mine operators. It is ten years since the Alaska coal fields were withdrawn from private entry and development. Secretary Lane has now restored about 33,370 acres of coal lands in the Bering River district and about 13,920 acres in the Matanuska district. These coal lands will be leased in tracts varying from 200 to 1,300 acres in size; the leasing units offered number 79. The leases are to be for a period of 50 years with a royalty to the government of 2c. per ton for the first five years, 5c. for the next 20 years, and a royalty not in excess of 5% of the selling price of the coal for the remaining 25 years. Proposals for leases are invited by the government, which will give preference to those who will make the largest investments and the earliest commercial developments.

Water Must Be Supplied by New York City to municipalities in Westchester County, according to the terms of the legislative act recently signed by Governor Whitman. Under previous legislation the consent of the State Conservation

Commission was necessary before this could be done. The City of New York, the Merchants Association and other organizations strongly urged the Governor to veto the bill, but he stated that New York City had the matter wholly within its own control since it was able to fix the water rate to be charged—apparently meaning that the rates to be charged municipalities in Westchester County are to be the same as those charged by and in New York City. The Governor added in his memorandum:

> If it [New York City] is financing this enterprise upon a proper business basis, it is including in its water rates adequate interest and sinking-fund charges to meet the indebtedness incurred in the establishment of the system.

Five Million One Hundred Thousand Dollars for Chicago bridges was the main item of the bond issue authorized in the election held in Chicago on June 5. The extensive plans of the engineers, which these bonds are to cover, include nine bascule bridges over the Chicago River, in the business district, at a cost of $300,000 to $600,000 each. Seven of these will replace existing bridges, some of which are bascule spans and others center-pier swing spans, and they will eliminate practically all the center piers, thus giving a clear river channel. Two of the bridges will be additional crosings of the main arm of the river, at Franklin and La Salle St. These, with the new Michigan Ave. double-deck bridge (to be built under other arangements) will greatly improve the communication between the north and south districts and reduce the present congestion. Besides these large bridges there will be the construction and reconstruction of a number of smaller structures. The new bridge project is under the direction of John Ericson, City Engineer.

A 72-In. Reflecting Telescope, the largest yet completed, has just been finished by the Warner & Swasey Co., of Cleveland, for the Dominion Astronomical Observatory, Victoria, Canada. This telescope is of equatorial-mounting type, supported at north and south ends by bearings in a direction parallel to the earth's axis. The declination axis to which the tube is attached, at 90°, passes rectangularly through the central cubical portion of the polar axis. The instrument weighs 55 tons and will rest on concrete piers. A precision driving clock moves the telescope in right ascension, through an accurately cut worm wheel 9 ft. in diameter on the polar axis. The telescope is moved from one position to another and is set and guided by seven electric motors. The 72-in. mirror and optical accessories were made by the J. A. Brashear Co., of Pittsburgh. The revolving dome, made by Warner & Swasey Co., is 66 ft. in diameter and weighs 120 tons. It has a double shutter with an opening 15 ft. wide. All movements, including revolution, operation of shutter and wind shield, and control of observing bridge are controlled by electric motor.

Subway Ventilation through Sidewalk Gratings on the Broadway line in New York City has been investigated by Public Service Commissioner Henry W. Hodge. Nearly a year ago, on account of the protest of a large number of property owners against the placing of ventilating gratings in the sidewalks, the Public Service Commission referred the matter to a board of engineers for investigation. The report of that board was abstracted in "Engineering News" of Mar. 16, p. 531. It was to the effect that the ventilation through sidewalk gratings was on the whole the least objectionable of any practicable plan of ventilation. Protests were made to the commission against the adoption of this report, and the matter was referred to Commissioner Hodge for investigation. The Commisioner has recommended the elimination of sidewalk gratings between 29th and 35th St., and between 39th and 46th St. Between 35th and 39th St. it was found impracticable to eliminate the gratings because of the long distance to the nearest ventilating chambers and the difficulty in effectually forcing air over such long distances. Where the gratings are to be eliminated from the sidewalks, they are to be placed in parks and other open spaces along the roadway. It should be noted that this decision relates to points where the subway work is not yet completed and a change in the ventilating system is possible. Commissioner Hodge did not favor any changes in portions of the subway where the ventilating system is already completed.

PERSONALS

H. L. Hudson has resigned as Assistant City Engineer of Laporte, Mich., to engage in construction work in Indianapolis.

John E. George, of Baltimore, Md., has been appointed Assistant to Chairman Zouck, of the Maryland State Roads Commission.

Alexander P. Crary, Assoc. M. Am. Soc. C. E., of New York City has been appointed Resident Engineer on Dock Work in Baltimore, Md., of the Cleveland Dock Engineering Co.

R. C. Brown has been appointed Engineer of Maintenance of the San Pedro, Los Angeles & Salt Lake R.R., a newly created position. His headquarters will be in Los Angeles.

George J. Young, M. Am. Inst. M. E., now Professor of Mining Engineering in the University of Minnesota, has been appointed Professor of Metallurgy in the Colorado School of Mines.

Nathan W. Dougherty, Assistant Professor of Civil Engineering in the University of Tennessee has been appointed to succeed Prof. William Waller Carson as Professor of Civil Engineering.

J. E. Ellms, of Cincinnati, Ohio, has been appointed Temporary Superintendent of the Cleveland Filtration Plant, with a salary of $300 a month. Mr. Ellms will divide his time equally between the Cleveland and Cincinnati plants.

Edgar E. Calvin, Vice-President and General Manager of the Oregon Short Line R.R. and First Vice-President of the San Pedro, Los Angeles & Salt Lake R.R., has been elected President of the Union Pacific System, to succeed A. L. Mohler.

Gustav J. Requardt, Assoc. M. Am. Soc. C. E., Division Engineer, Sewage Disposal Plant, Baltimore Sewerage Commission, has resigned to become associated with the firm of Norton, Bird and Whitman, Engineers, of Chicago and Baltimore. His headquarters will be at 1320 Munsey Building, Baltimore, Md.

A. C. Southern has resigned as County Surveyor and Highway Engineer of Cole County, Mo. It is stated that he will be appointed circuit judge to fill an unexpired term (until the November election) caused by the death of Judge Frank G. Johnson.

Edward M. Stayton, M. Am. Soc. C. E., has been appointed County Surveyor and Highway Engineer of Cole County, Mo. Mr. Stayton studied civil engineering in the Missouri State University, and has had experience as Assistant City Engineer of Independence, Mo., as well as in railway work in Spanish Honduras and in the vicinity of Kansas City.

Charles G. Thornburg has resigned as Assistant Engineer in the Bureau of Water, City of Philadelphia, to accept the position of Resident Engineer at Port Henry, N. Y., for Frank C. Roberts & Co. on the construction of an ore dock for the Lake Champlain & Moriah Railroad Co. Mr. Thornburg graduated from Lehigh University in 1909. For the past year he has had charge of construction of the sedimentation basin at the Torresdale Filters, Philadelphia.

Frederick Clouston Moore, M. Am. Soc. M. E., has established an office at 710 Engineers Building, Cleveland, Ohio, as Consulting and Executive Engineer. He will act as consultant to owners and executives in all matters pertaining to factory or foundry operation, organization, production, equipment and accounting and costs, and will make special investigations, and reports on new manufacturing projects and on the financial, commercial and physical condition of established concerns. He will also give special attention to industrial and engineering problems.

James Flack Norris, who was recently appointed one of the five Tennesee members of the Naval Consulting Board, has tendered his resignation as Professor of Chemistry in Vanderbilt University and will go to the Massachusetts Institute of Technology to take charge of research work and graduate courses in chemical engineering. Dr. Norris is a graduate of Johns Hopkins University. He became connected with the Massachusetts Institute of Technology after his graduation in 1893, rising to the position of Assistant Professor of Organic Chemistry. He was formerly President of the Northeastern Section of the American Chemical Society, and is the author of "Principles of Organic Chemistry" and other treatises.

William Waller Carson, M. Am. Soc. C. E., has resigned as Professor of Civil Engineering in the University of Tennessee on account of advancing years and has been made professor emeritus by the Board of Trustees. Professor Carson is one of the oldest professors of engineering in point of service in the country. He was born in Adams County, Miss., in 1845. He was a member of the Confederate Army and rose from private to sergeant-major. He obtained his engineering degree at Washington College (now Washington and Lee University) in 1860, and from 1877 to 1883 was instructor in mathematics at Davidson College. He became a member of the faculty of the University of Tennessee in 1885. Professor Carson is also a member of the Engineering Association of the South and the Society for the Promotion of Engineering Education.

OBITUARY

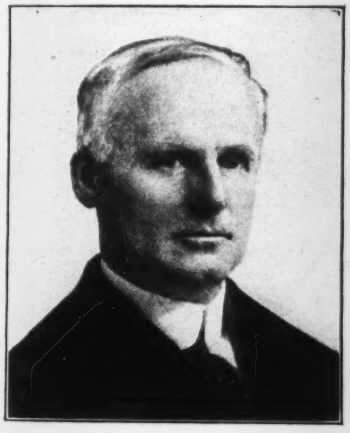
John C. Ryan, a civil engineer, of Rochester, N. Y., died on May 23, at 66 years of age. Mr. Ryan had been prominently known in Rochester for many years.

Elswood Usinger, member of the Gloucester County, New Jersey, Board of Freeholders, a prominent road and bridge builder died on May 31, at 68 years of age. Mr. Usinger was also a member of the Delaware River Bridge and Tunnel Commission.

Francis Rowland Porter, Manager of the Fire Underwriters' Inspection Bureau, of San Francisco, Calif., died on May 19. He was born in Boston, Mass., and went to California in 1882. In 1884 he entered the employ of the Pacific Insurance Union of San Francisco as a fire-insurance surveyor, and in 1885, when the Bureau named "Inspection Bureau of the Underwriters' Fire Patrol" was formed, he was appointed Chief Inspector. A few years later the bureau changed its name to Fire Underwriters' Inspection Bureau.

Edward Russell, one of the best known granite men in the United States, died at his home in Gloucester, Mass., on June 3. Mr. Russell had been identified with some of the largest construction enterprises in this country. He quarried and successfully transported to sea on a lighter specially constructed for the purpose, what is claimed to be the longest single piece of granite on record, used in the construction of the main arch of the Cathedral of St. John the Divine, in New York City. He was 83 years old.

Charles Sooysmith, M. Am. Soc. C. E., Consulting Engineer, died at his home in New York City, on June 1, at 60 years of age. He was born in Buffalo and was the son of the late Gen. William Sooy Smith, of Chicago. He received his civil engineering degree from Rensselaer Polytechnic Institute and spent two years in study abroad, part of the time attending the Polytechnicum at Dresden. In 1879 he was appointed Assistant Superintendent of the Department of Track, Bridges and Buildings of the Atchison, Topeka & Santa Fe R.R. He left that position two years later to join his father in the firm of Wm. Sooy Smith & Son, engineers and contractors. In 1887 he organized and became president of the firm of Sooysmith & Co., contracting engineers, and during the next ten years constructed many important railway bridges in the South and West. He was also chief engineer in the construction of Central Bridge over the Harlem River at New York City. Mr. Sooysmith introduced the pneumatic-caisson method for sinking the foundations of high buildings. In New York City his company erected the following buildings: Manhattan Life, the American Surety, Empire and Washington Life buildings. He also introduced into this country the freezing method for making excavations and greatly improved and developed it, and perfected plans for the application of the process to the construction of subaqueous tunnels. Since 1898 he had occupied offices at 71 Broadway, New York City.



CHARLES SOOYSMITH

Thomas McNeil, Sr., President of the James McNeil & Bro. Co., died on May 28, in his 76th year. He was born in Rutherglen, Scotland, and came to America when eight years old, settling with his parents in Canada, where he remained until 1860, when he went to New York City. During the Civil War Mr. McNeil was employed in the United States Navy Yard at St. Helena Islands, looking after transport vessels. In 1865 he located in Pittsburgh, and with his brother James started in the boiler business, which business was incorporated in 1900 under the present name of James McNeil & Bro. Co. Mr. McNeil was granted several patents in connection with his business and was one of the first manufacturers to advocate and develop riveted steel pipes for large-diameter conduits. He was considered an authority in steel-plate construction work.

ENGINEERING SOCIETIES

SOCIETY OF AUTOMOBILE ENGINEERS.
June 12-16. Summer meeting (cruise on Lake Huron and Georgian Bay). Secy., Coker F. Clarkson, 29 W. 39th St., New York City.

MASTER CAR BUILDERS' ASSOCIATION.
June 14-16. Annual meeting, Atlantic City, N. J. Secy., Jos. W. Taylor, Karpen Bldg., Chicago.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.
June 14-17. Eighth semiannual meeting. Cleveland. Secy., I. C. Olsen, Cooper Union, New York City.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.
June 14-21. Convention in Atlantic City. Secy., J. D. Conway, 2136 Oliver Bldg., Pittsburgh.

SOCIETY OF RAILWAY CLUB SECRETARIES.
June 16-17. Annual meeting in Atlantic City. Secy., H. D. Vought, 95 Liberty St., New York City.

AMERICAN RAILWAY MASTER MECHANICS ASSOCIATION.
June 19-21. Annual meeting, Atlantic City, N. J. Secy., Jos. W. Taylor, Karpen Bldg., Chicago.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION
June 19-22. Annual meeting in Charlottesville, Va. Secy., F. L. Bishop, University of Pittsburgh, Pittsburgh.

TRI-STATE WATER AND LIGHT ASSOCIATION OF THE CAROLINAS AND GEORGIA.
June 21-23. Annual convention at Isle of Pines, S. C. Secy., W. F. Stieglitz, Columbia, S. C.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 27-30. Annual meeting in Pittsburgh. Secy., Charles Warren Hunt, 220 West 57th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS.
June 27-30. Annual meeting in Atlantic City. Secy., Edgar Marburg, University of Pennsylvania, Philadelphia, Penn.

The American Public Health Association will hold its annual meeting in Cincinnati Oct. 24 to 27. The secretary is Prof. Selskar M. Gunn, Boston.

The American Society of Municipal Improvements will hold its 1916 convention Oct. 9 to 13, in Newark, at the Robert Treat Hotel. The secretary is Charles Carroll Brown, Indianapolis, Ind.

The Southwestern Concrete Association was organized at a meeting held in Kansas City, Mo., on May 26. The purpose of the association is "for discussing the various questions arising from time to time in the uses of concrete, and to exchange views as to the best methods to extend and develop its use." The officers are as follows: President, G. B. Appo, publisher of "Portland Cement"; 1st vice-president, Martin Carroll, general contractor; 2nd vice-president, W. F. Fague, with Sunflower Portland Cement Co.; secretary, H. H. Peters, manager "Western Contractor"; treasurer, Chas. A. Stevenson; all of Kansas City, Mo.

The Colorado Association of members of the American Society of Civil Engineers will hold its annual meeting and 77th regular meeting, in Denver, on June 10. An informal dinner will precede the meeting and at the latter the principal speaker will be J. C. Lippincott, Consulting Engineer of the Los Angeles Aqueduct Bureau, whose subject will be "The Construction and Operation of the Aqueduct." The Los Angeles Aqueduct though primarily a water-works system provides for the irrigation of 135,000 acres of land and for the development of a maximum of 120,000 hp. The regular meetings of the association will be omitted during July and August, but the usual Wednesday luncheons will be continued. The secretary is L. R. Hinman, 1400 W. Colfax Ave., Denver, Colo.

Appliances and Materials

Tetrachloride Fire Extinguisher

A type of carbon-tetrachloride hand fire extinguisher is being put out by the H. W. Johns-Manville Co., of New York City, combining the advantages of pump and compressed-air tank units. There is, as a part of the extinguisher, a hand pump by which the air pressure on the liquid can be secured; then a nozzle valve is used to control the stream. It is claimed that this combination has been found of advantage in restricted spaces where there is not room for working the pump close up to the blaze.

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New Turbo Blower

A new turbo blower of capacity ranging from 3,000 to 35,000 cu.ft. of free air per min., at 2½ lb. pressure, has been added to the line of the Ingersoll-Rand Co., of New York City. It is of the single-stage, double-flow type and can be furnished with electric motor, steam turbine, or waterwheel.

The blower unit is of the four-bearing construction featured in all turbo machines of this make. The impeller is of

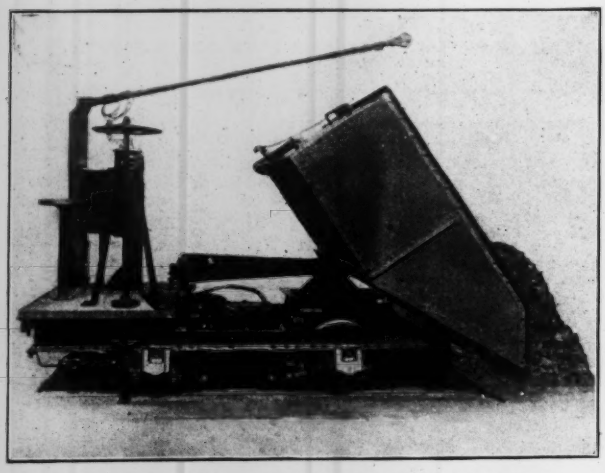
the inclosed double-flow type, the wheel being machined from a solid steel forging. Vanes and covers are of pressed steel. The blower is particularly adapted to such services as foundry-cupola blowing, atomizing oil for oil burners, supplying blast to heating and annealing furnaces, blowing air for water-gas generators, and for pneumatic conveying and ventilating.

Ingersoll-Rand also builds multi-stage centrifugal blowers of capacities ranging from 3,000 to 60,000 cu.ft. of pressure up to 30 lb., and turbo compressors up to 100-lb. pressure.

* * *

Self-Propelled Dump Car

A motor-driven dump car that can be handled by one man is now manufactured by the Orenstein-Arthur Koppel Co., of Columbus, Ohio. The car, which in the accompanying view is shown discharging its load, has the following dimensions: 9



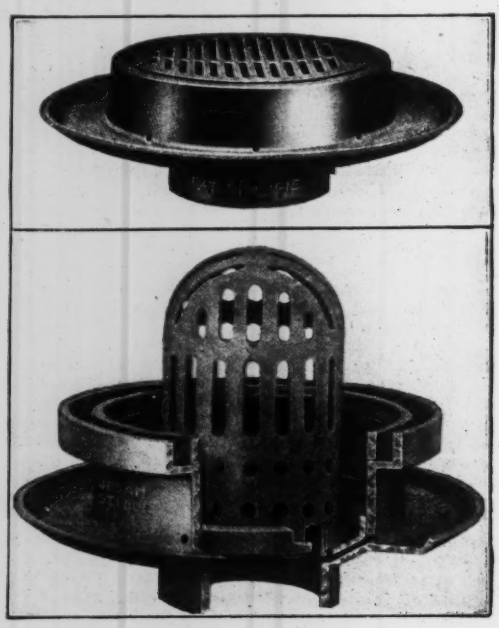
MOTOR DUMP CAR DISCHARGING LOAD

ft. 8 in. by 5 ft. 10 in. in plan by 4 ft. 8 in. high. The capacity is 54 cu.ft. The car is built for any gage from 36-in. to standard, and is equipped with motors for either alternating or direct current.

* * *

Anti-Seeping Roof and Floor Drain

A new type of roof and floor drain head, preventing leakage from around a strainer head down along the drain pipe, has been evolved by the Josam Manufacturing Co., of St. Louis, Mo., the important feature being shown in the accompanying view. This is a wide cup flange to be built in the roof or floor construction, catching all seepage which may occur between the strainer box and the roof or floor surface. Small drain holes lead from the cup into the drain. Various forms of this "Double Drainage Drain" (its trade name) are made in cast iron and brass for wood and concrete roofs, tile floors, etc. Some have variously combined traps and back-water valves, swing joints, adjustable strainers, screw or soil-pipe ends, single and double sediment cups (for catching tar, gravel, etc., on composition roofs), non-tilting gratings, clamps for lead flashing under tile floors, etc. These drains have recently been used in public schools, hotels, hospitals, warehouses, etc., and are accepted for use under the "uniform plumbing specifications of the U. S. Treasury, War and Navy Departments." The prices range from $6.50 for a 2-in. simple drain head to $12 for a 2-in. trapped box, $24 for a trapped box with ball valve, and $28 for an 8-in. roof drain with removable sediment cup.

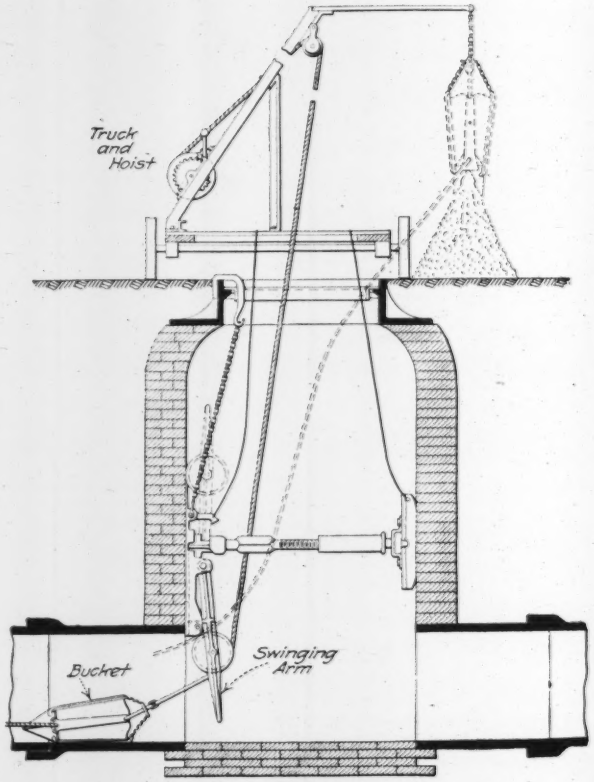


JOSAM PROTECTED ROOF DRAINS

* * *

Sewer-Cleaning Machine

The Kuhlman sewer-cleaning machine, shown herewith, uses an expansion bucket fitted with cutting jaws and operated by two ⅜-in. cables 300 ft. long. The bucket can be drawn through from one manhole to another, or it can be drawn in until it is filled and then withdrawn. In the latter case, when its motion is reversed the cutting jaws close up and prevent the contents of the bucket from falling out. Each cable is operated by a hand-power drum mounted on a wheeled truck, having a gallows frame at the front end, with an arm to project over the manhole opening and handle the bucket in dumping. A special feature is a hinged jack arm placed at the bottom of the manhole to guide the bucket and cables and prevent them from striking and injuring the mouth of the sewer. This arm is pivoted to a brace



KUHLMAN SEWER-CLEANING MACHINE

across the manhole and carries a guide pulley for the cable. Normally it hangs over the mouth of the sewer pipe, but as the bucket is pulled out it engages the arm, which swings to a horizontal position and so carries the bucket out to the center of the manhole. In lowering the bucket, the arm keeps it clear of the sides until the bottom is reached and then swings it into the sewer opening. The device is the invention of John F. Kuhlman, Commisioner of Public Works at Hammond, Ind. It is manufactured by the Champion Potato Machinery Co., Hammond, Ind., and sells for $500, complete.